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# approach

THE NAVAL AVIATION SAFETY REVIEW

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TECHNOLOGY & SCIENCE



the most



accuracy?

# Toward an *OPTIMUM APPROACH*

Jet aircraft landing approaches are critical and demanding of the pilot's abilities. Using the constant angle of attack—constant glide slope approach can benefit accuracy, consistency and the relative ease with which it can be flown. What are the necessary pilot requirements and aircraft characteristics?

**F**rom a pilot viewpoint the landing approach in modern jet aircraft is most critical and demanding of his abilities. Accurate control of airspeed and sink rate combined with the requirement for attaining an accurate touchdown point require intense pilot concentration and effort.

The difficulty associated with this problem is amply illustrated by Navy accident statistics over the past five years. A high percentage of Navy aircraft accidents in high performance airplanes occurred during this critical phase of flight. Certainly, it is true that the Navy's unique problem associated with shipboard operations has tended to boost this percentage.

## A Little History

Prior to the advent of jet aircraft, the short stopping distances of reciprocators and their inherent airspeed-power stability in the approach configuration made the landing approach problem less demanding. The arrival of the first jets was accompanied by an increase in runway length and very little change in landing approach techniques. As high performance, supersonic airplanes came on the scene, still longer runways were built and again approach procedures were relatively dormant.

One type of approach used in reciprocating engine days is still in use in some of today's opera-



tions. In this type of approach the pilot plans changes of altitude, airspeed, sink rate, and distance from touchdown so that on completion of the approach he will arrive at the correct touchdown point, on airspeed, in the correct attitude, and with the desired sink rate.

In flying this type approach the pilot bases his judgment on instrument readings in the cockpit (airspeed, altitude, vertical speed), depth perception and a *knowledge* of airplane characteristics. The approach is normally flown at a relatively fast airspeed and a flare is used to dissipate airspeed and reduce sink rate at touchdown. Under night and IFR conditions a similar approach technique is used—except that GCA and/or ILS information

is normally used to define the desired glide slope. However, the approach is again usually flown at a fast airspeed, and the requirement for a flared landing still exists.

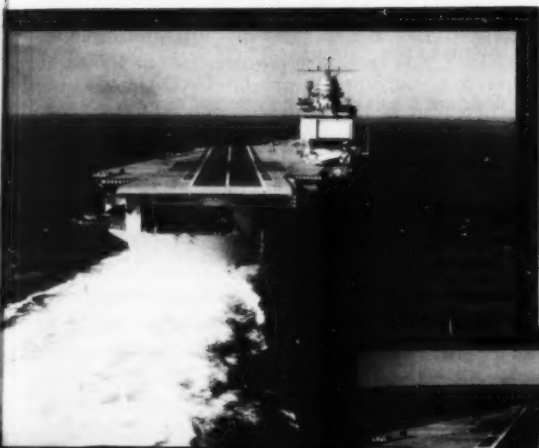
The Navy, because of its unique requirement of shipboard operations, has within the past few years adopted and utilized a constant angle of attack (CAOA) approach on a defined glide slope as the primary approach method for both ship and shore operations.

Use of this approach technique can provide for optimum landing performance and safety of operation in modern jet aircraft. In addition, certain airplane flying qualities and performance characteristics enhance the ease with which the pilot can make this approach. However, various landing aids are required to give the pilot an adequate and complete presentation of the flight conditions he needs to monitor in such an approach.

#### Approach Technique

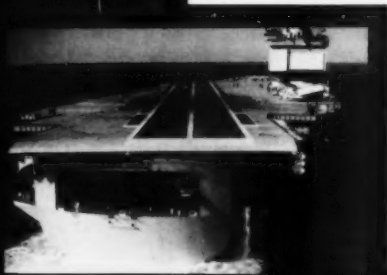
What are some of the benefits from using the constant angle of attack/constant glide slope type of approach?

- *Primarily*, the accuracy with which the attainment of desired touchdown point at the desired attitude and sink rate can be obtained.



by

Lt. Edward J. Hogan





Accuracy and consistency lead to (OK) 3 wire.

• **Secondarily**, the consistency with which an accurate attainment of the above parameters can be obtained.

• **And finally**, the ease with which the pilot can fly the approach which gives the accuracy and consistency desired.

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**Accuracy**—This is the primary benefit from using the Navy constant angle of attack/constant glide slope (CAOA/CGS) type approach. The airplane is stabilized in the desired touchdown attitude, flown on a known glide slope, and directed to an accurate touchdown point. The pilot is not confronted with any airspeed or sink rate programming and no flare is required. This enables landings to be made both IFR and VFR, day and night, in the same manner. Conditions which reduce the pilot's depth perception ability have only minimal effects on this type approach.

Accuracy can be attained as illustrated by the results recently obtained in an evaluation of operational Navy fighter and light attack airplanes. An airspeed dispersion of  $\pm 4.2$  kt (3.1%), a sink rate dispersion of  $\pm 1.0$  fps (5.9%), and a touchdown point accuracy of  $\pm 30$  ft is possible.

**Consistency**—The accuracy attained in utilizing the CAOAC/CGS approach can be consistently attained. Reams of additional data are available to substantiate this consistency. It is significant to note that the accuracy previously described is ideal for normal, safe operations aboard ship. Operating Navy squadrons should be able to attain this accuracy in everyday operations, both afloat and ashore. What does it take? Work, pride, a professional attitude and some knowledge of what the aircraft can do in the approach and why.

**Pilot Requirements.** By utilizing this type of approach, the pilot can, if given reasonable airplane characteristics, perform his assigned task in the approach with relative ease. Sure, the pilot must concentrate and exercise piloting skill, but he is confronted with a less complicated task than other type approaches would require.

The CAOAC/CGS approach ideally requires that the airplane be stabilized at the optimum angle of attack (AOA) as the pilot commences his final approach descent on the glide slope. He is given a 1 to  $1\frac{1}{2}$  mile final approach course—which amounts to a 30 to 40 second period in most modern airplanes. *If the airplane is stabilized on altitude, attitude and power as the pilot commences his approach descent*, his task is simply to maintain angle of attack, the desired glide slope (sink rate), and lineup to touchdown.

One final advantage of the CAOAC/CGS approach is that in the approach the effects of airplane gross weight, load factor, and bank angle are automatically compensated for. Thus, if an optimum approach AOA is selected which gives sufficient stall margin, adequate airplane stability and response, and a proper landing attitude, the pilot is always presented with this information and he is required to make few and small compensations.

**Sink Rate.** Admittedly, the sink rates on touchdown with the CAOAC/CGS type approach are higher than those obtained with a flared landing—but it is a known quantity with a predictable dispersion. On considering the design requirements of undercarriages to withstand the loads associated with these sink rates, the usual complaint is *increased weight and loss of performance*. The



What aircraft characteristics give the pilot an acceptable task in flying his approach?

fact that the Navy's front line fighter, the *Phantom II*, holds or has held the majority of the world performance records is a significant contradiction to this argument.

The capability of all Navy fighter, attack, and even its turboprop anti-submarine patrol airplanes to perform their assigned tactical missions has not in any means been degraded by the requirement to withstand these high undercarriage loads. It follows then that if these sink rate requirements are known, it is possible to design the desired airplane and undercarriage strength without limiting the desired performance characteristics.

If devices such as boundary layer control, variable incidence, variable sweep, and even vectored thrust are used to reduce the approach airspeeds associated with the CAO/CGS approach, a significant reduction in sink speed and a possible lessening of strength requirements could result.

#### Airplane Characteristics in the Approach

Since we accept the premise that the CAO/CGS approach will give optimum results, and that airplane design can and does produce the strength necessary to absorb the associated high sink loads, we must then determine what airplane characteristics give the pilot an acceptable task in flying this type of approach. Briefly then, let's evaluate these characteristics.

**Stability.** The three stability parameters of prime interest in the CAO/CGS approach are the longitudinal static, the phugoid, and the airspeed-power stability modes. Longitudinal short period and lateral-directional requirements, although of significant importance, particularly under gust and crosswind conditions, can be relegated to a secondary position.

**Longitudinal Static Stability.** Positive forces and position gradients with changes in airspeed have long been a specification requirement for Navy aircraft. Recent Navy jet aircraft have, in the majority, exhibited only weakly positive force and position gradients and in many cases have been below specification requirements. This is true even after exotic artificial feel systems have been incorporated to produce the desired force gradient. See figure 1 for a comparison of a low and steep gradient.

This would at first appear to be a grave deficiency. However, pilots do not consider this unsatisfactory. As long as the force gradient is positive, even with a low value, and the pilot is given some indication of a variation from his trim speed,

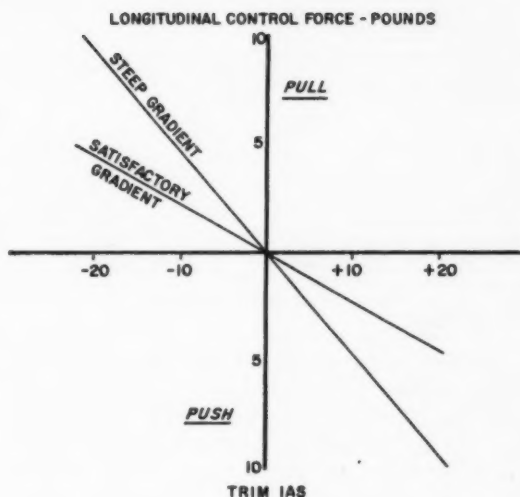


Fig. 1 — Static longitudinal stability force gradients.

he is usually satisfied. In fact, a steep gradient is considered poor in many cases because of the increased trimming requirements and heavy stick forces associated with small airspeed changes. Pilots tend to consider the lightly positive force gradient as ideal.

**Phugoid Damping.** Several recent Navy airplanes in the approach configuration have exhibited a lightly damped phugoid oscillation. (The first mode of dynamic longitudinal stability consists of a very long period oscillation, referred to as the phugoid.) The phugoid or long period oscillation involves noticeable variations in pitch attitude, altitude, and airspeed but *nearly constant angle of attack*. (See fig. 2.)

With the relatively long period the pilot is in during the final approach descent (30-40 sec) the wandering airspeed of the phugoid definitely requires increased pilot attention. Recent tests with automatic throttle devices have indicated that utilization of engine thrust does increase the phugoid damping markedly, particularly when engine response to airspeed errors is rapid. This can also be accomplished (and is) manually by the pilot.

**Airspeed-Power Stability.** Let's consider the Navy airplanes which have exhibited the previously mentioned low force stability and light damping of the phugoid.

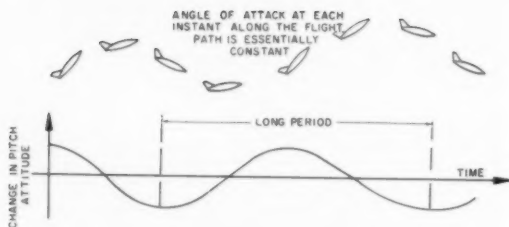


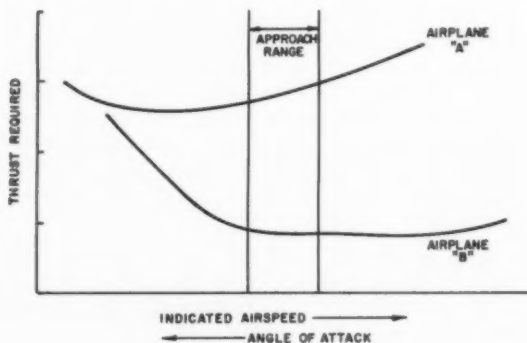
Fig. 2 — First mode or phugoid.

Airplane A has strong airspeed-power stability while airplane B's airspeed-power stability is excessively low. Qualitatively, airplane A is graded as having "outstanding approach characteristics" while airplane B is deemed most difficult to fly in the approach configuration. This strong or weak stability is directly related to the power-required curves of each airplane.

Figure 3 shows the essential differences in power required in the approach configuration of these two airplanes. Airplane A, with the definite gradient in the approach AOA range, has the airspeed-power stability. This permits the pilot to establish the desired AOA, select the power required to maintain that AOA on the desired glide slope, and then to stabilize. The airplane will not tend to diverge from speed if small pitch attitude corrections are made to maintain glide slope.

On the other hand, airplane B with the shallow

Fig. 3 — Power required curves



gradient is extremely difficult to stabilize, and when pitch attitude corrections are made, the airspeed tends to change rapidly. It should be obvious that airspeed-power stability is of paramount importance.

### Aircraft Control

In making the CAO/CGS type approach, the pilot is primarily interested in the *initial airplane response* to control inputs. The ability of the airplane to obtain high rates of movement after prolonged control applications is not of any significant value. Let's take a look at these control requirements.

**Longitudinal.** The short period frequency of the airplane is of importance when response to longitudinal control inputs is considered. When a pilot makes an altitude or glide slope correction by use of the stick he is exciting the short period mode and the response he notes is a function of the *short period frequency*.

From a flying qualities viewpoint the pilot is interested in what control force and movement is needed to attain this aircraft response, with primary emphasis being on stick force. Too light a force would cause the airplane to be oversensitive and too heavy a force would be objectionable from a pilot effort standpoint.

In control system design the lb-per-inch of stick deflection which reflects the pilot's work in performing the desired longitudinal task is considered. A value of 8 to 12 lb-per-inch is considered to be in the optimum range. The problem of giving the pilot this *optimum feel* is solved by control power and gearing the system.

**Lateral.** Extensive flight tests at the Naval Air Test Center indicate that airplanes capable of attaining a bank angle of 20° within one second have satisfactory lateral response for flying the CAO/CGS approach. This response, plus a minimal amount of adverse yaw (preferably zero), in attaining this response will give satisfactory flying qualities. The pilot, once again, is also interested in the stick force and movement required to attain the desired response.

Pilots recently have indicated a desire for tight lateral control systems with a throw of three inches or less right and left. This, in conjunction with a sensitivity of 4 lb-per-inch, gives the pilot a satisfactory feel. Combine this feel with the response of 20° bank angle in one second and the lateral handling qualities should be optimum.

**Directional.** The majority of pilots of the modern

high performance aircraft desire to make heading or line-up adjustments in the approach by use of lateral control alone. Except for use in crosswind conditions and as a convenient place for the brake pedal, the rudder is becoming of secondary importance. In airplanes where adverse yaw limits the ability of the lateral control to make the desired heading corrections, an aileron-rudder interconnect (ARI) is usually installed. The use of the ARI to give zero adverse yaw and the aforementioned lateral response will give the pilot satisfactory heading and line-up control in the approach.

### Performance

A sufficient margin of power available over power required and rapid engine response are the prime performance requisites. Fortunately, the majority of our recent jet engines have provided us with both of these characteristics and future engines should continue to do so. Figures 4 and 5 illustrate satisfactory values recently obtained in several Navy airplanes.

Another consideration is the ability of the pilot to select the desired power, or in other words the sensitivity of the throttle. Since we have an airplane operating with positive airspeed-power stability, we must give the pilot accurate control

Fig. 4 — Power available and power required curves

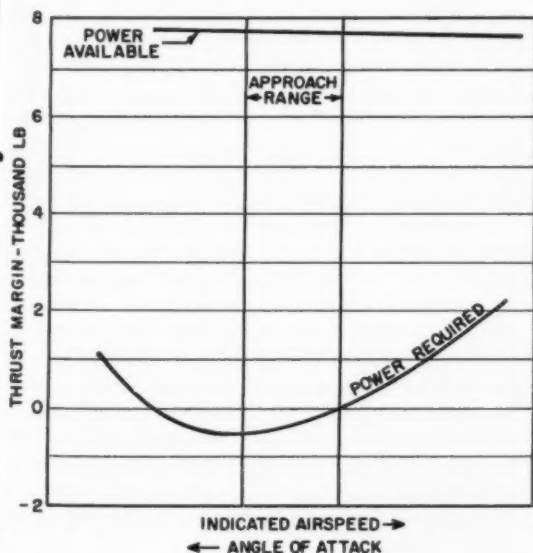
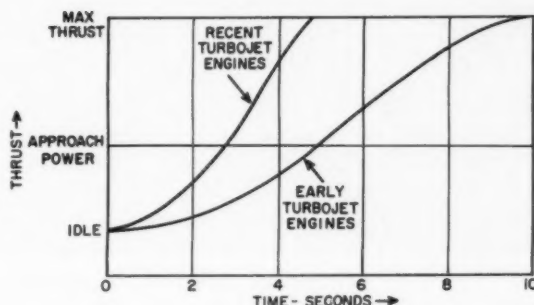


Fig. 5 — Engine response curves.



of the engine power settings. This is a problem of throttle quadrant mechanism design. Too sensitive a throttle will cause the pilot to over-control angle of attack and sink rate corrections, while a throttle quadrant which requires large power lever control movements would be objectionable from a pilot work load standpoint.

### Airplane Geometry

If aircraft design can give the stability and control and engine performance at the optimum AOA, consideration then is given to the relative location of cockpit, undercarriage, and tailpipe, at this AOA, and the effects of these combinations on forward visibility, ground clearance of tailpipe, and several other significant parameters.

This facet of the overall approach design criteria has caused some rather interesting innovations, such as variable incidence, a two-position rotating pilot's seat, and a rotating forward nose section. Less complicated means of attaining the desired results might have been available if early consideration to the basic airplane geometry requirements at the optimum approach angle of attack had been made. These criteria should definitely be given careful consideration on all future aircraft.

### Automatic Control Systems

The airplane longitudinal, lateral and direction control characteristics previously discussed which enhance the ability of the pilot to perform his assigned task in the approach will also ease the requirements of an approach power compensator (APC) and/or an automatic flight control system (AFCS). If an AFCS and APC are used to perform an automatic approach and landing, the simplicity of tasks required in the CAOAC/CGS

approach reduces the complexity of requirements in the automatic system.

#### Landing Aid Displays

Accurate and easily discernible displays of the conditions the pilot is required to monitor during the approach is a definite requirement for proper utilization of the CAO/CGS approach. These parameters include angle of attack (AOA), airplane attitude, glide slope, line-up, and in most modern airplanes some indication of engine thrust.

#### Cockpit Displays

"Head up" by all means. The pilot in the CAO/CGS approach is required to establish and then monitor AOA, glide slope, and line-up. Ideally, as the final approach descent is commenced, his technique should be to establish the desired sink rate, make power and attitude adjustments to maintain that sink rate at the desired AOA, and maneuver to establish and maintain line-up. Early establishment of these factors in the approach is a prerequisite to successful performance.

If line-up and AOA are established and stabilized early, the pilot can, in the final phase, concentrate primarily on glide slope, and attain the accurate touchdown point desired. The requirement to establish and monitor all these parameters exists for all approaches, IFR and VFR, day and night.

Consideration must then be given to the ideal presentation of these so that the pilot can readily scan all the information available to him. Cockpit displays must also be compatible with any external landing aids utilized. This is where utilization of the "head up" display can be of significant value, particularly under low visibility conditions.



The pilot is primarily interested in the initial aircraft response to control inputs.

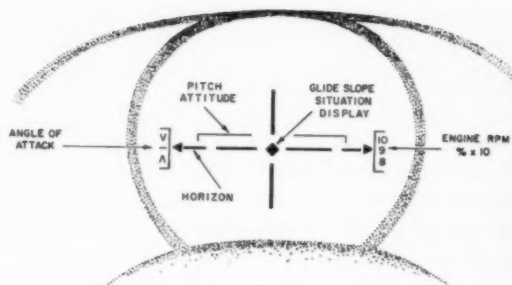
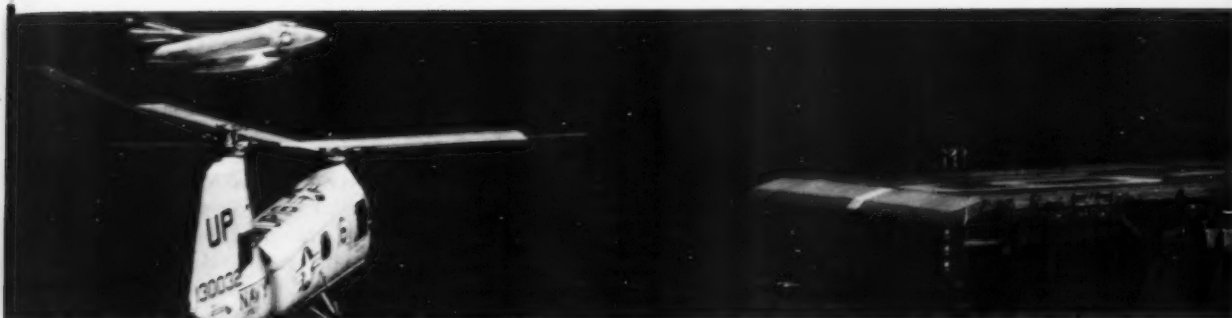


Fig. 6 — Optical head up approach situation display.

It allows early discernment and integration of external VFR landing aids and internal instrument displays. The parameters of AOA, airplane attitude, glide slope, and engine thrust are all of prime interest to the pilot and should be part of the display. (*The requirement for engine thrust display exists because frequent thrust changes are required to establish and maintain the desired AOA and glide slope. The pilot then should have a ready reference as to the amount of correction he has made from the desired stabilized power setting.*)

In practice under instrument or night conditions the pilot can use the present instrument display systems and navigation aids to establish himself in the approach pattern at the desired altitude and on the desired course. As the final approach descent is commenced, he can then reorient his scan to a "head up display" for the final phase. In the approach under day VFR conditions, he can utilize the display to augment his visual clues. However, under all conditions, he has the "head up" display, providing the same approach picture, and he need never return to a "head down" condition during the approach.

If optics are used in this display, the pilot's eyes will be focused on infinity and the present problem of *look outside, refocus, look inside, refocus* will be eliminated. This means earlier acquisition of any external landing aids. Figure 6 presents a proposed optical "head up" display. In this display glide slope information could be given by radar/data link with the source of the remaining information being all internal. Aside from providing invaluable assistance in a pilot-controlled approach, the "head up" display will also be extremely useful as a monitor during an automatic landing.



When aircraft characteristics and landing aid displays are improved, increased safety will result.

### External Landing Aid Displays

External aids are a definite requirement under all conditions. Even with an automatic landing system, an external glide slope monitor must be provided and used, where possible. Significant efforts have been made by the Navy to improve its present mirror and fresnel lens systems. Emphasis has been placed on centerline presentations in order that line-up and glide slope information can be combined. *(A crosslight landing aid is presently being developed and evaluated which should be a significant improvement over the presently available mirror and fresnel lens system. —Ed)*

An external aid coupled with the "head up" display does provide a compatible and useful system for all except the most extreme visibility conditions. Under true zero-zero conditions the external aid will obviously be useless, and then the pilot's reliance must be placed on the accuracy of the internal display presentation and/or the automatic landing system.

Briefly, it is concluded that:

- Utilization of optimum landing approach techniques which insure accurate and consistent per-

formance is a prerequisite for successful and safe flight operations. An approach to this problem which permits "haphazard landing approaches" will produce poor results. The CAO/CGS approach provides the answer. It's up to the pilot to fly it properly.

- The pilot or AFCS must be provided with optimum stability, control and engine performance characteristics in areas of prime interest in the CAO/CGS approach. These include positive airspeed stability, good engine response, and satisfactory longitudinal and lateral control response.

- Accurate and easily discernible presentation of airplane attitude, AOA, and glide slope position which can be readily integrated with external landing aids and VFR clues is also a requirement. A "head up" optical display is the most promising course of action in this area.

- The Navy has long ago adopted the CAO/CGS approach and is attempting to meet the airplane characteristics and landing aid display to enhance performance in the approach and landing. As these requirements are met, a noticeable increase in safety of operations is anticipated.

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Lieutenant Ned Hogan graduated from the U.S. Naval Academy in 1954. Upon completion of flight training in 1956 he reported to Fighter Squadron Thirty-Three where he served as LSO and Aviation Safety Officer. In 1960 Lieutenant Hogan attended the Empire Test Pilot School. After graduation he was assigned as a project pilot in the Flight Test Division at the Naval Air Test Center, Patuxent River, Md. Earlier this year he participated in the AGARD Flight Mechanics Panel (takeoff and landing symposium) in Paris, France.

Lieutenant Hogan, a member of the Society of Experimental Test Pilots, is currently serving as Aide and Flag Lieutenant to Commander Carrier Division Four.



# SLICING IT THIN

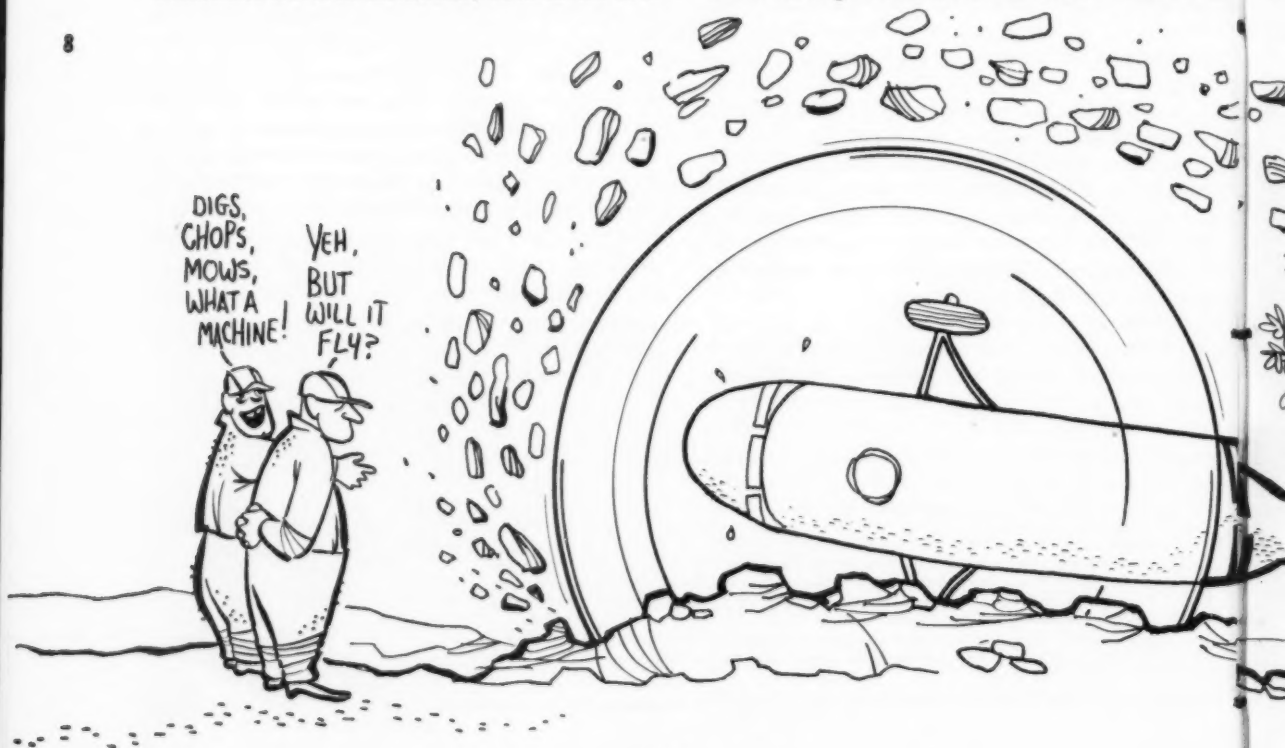
Once upon a time an inexperienced layman, waxing enthusiastically about the versatility of the helicopter, put forth the opinion that it would make an excellent welldigger when inverted, and if turned on its side, could trim hedges, mow lawns, or dig ditches, depending on the altitude. It's a pretty good guess that this fellow wasn't an operations officer, and it's certain that he wasn't a maintenance officer. At the present state of the art, rotor blade structural integrity just isn't up to that sort of thing.

From time to time, however, helicopter drivers slice into various things with their rotating blades. Sometimes it's even intentional, such as the tech-

nique developed by a pair of CG pilots during a flood disaster, wherein they would snip TV antenna guy wires with the main rotor and then blow over the antennas in order to effect rooftop pickups. But for every instance of this nature, there are dozens of the purely OOPS! variety.

In all fairness, most of the unintentional strikes occur when the pilot must necessarily operate in very tight quarters and when the last thing in the world that he could want would be to have the rotor contact anything whatsoever. Nevertheless, in the past we've chewed up a fair share of trees, telephone wires, alder bushes, whip antennas and sailboat masts. There are folks around who can remember a few years back down Florida way when one pilot gave a palm tree a neat crew cut.

It is fortunate that the rotor blades come off winner in most bouts. But not all. Less than two years ago a pilot and a medevac patient were killed when the helicopter blades caught the superstructure of a ship during takeoff. Those of us who have seen the stark motion picture coverage of this accident will never forget the instantaneous violence of that scene. Just a matter of a few inches changed this from a routine mission into

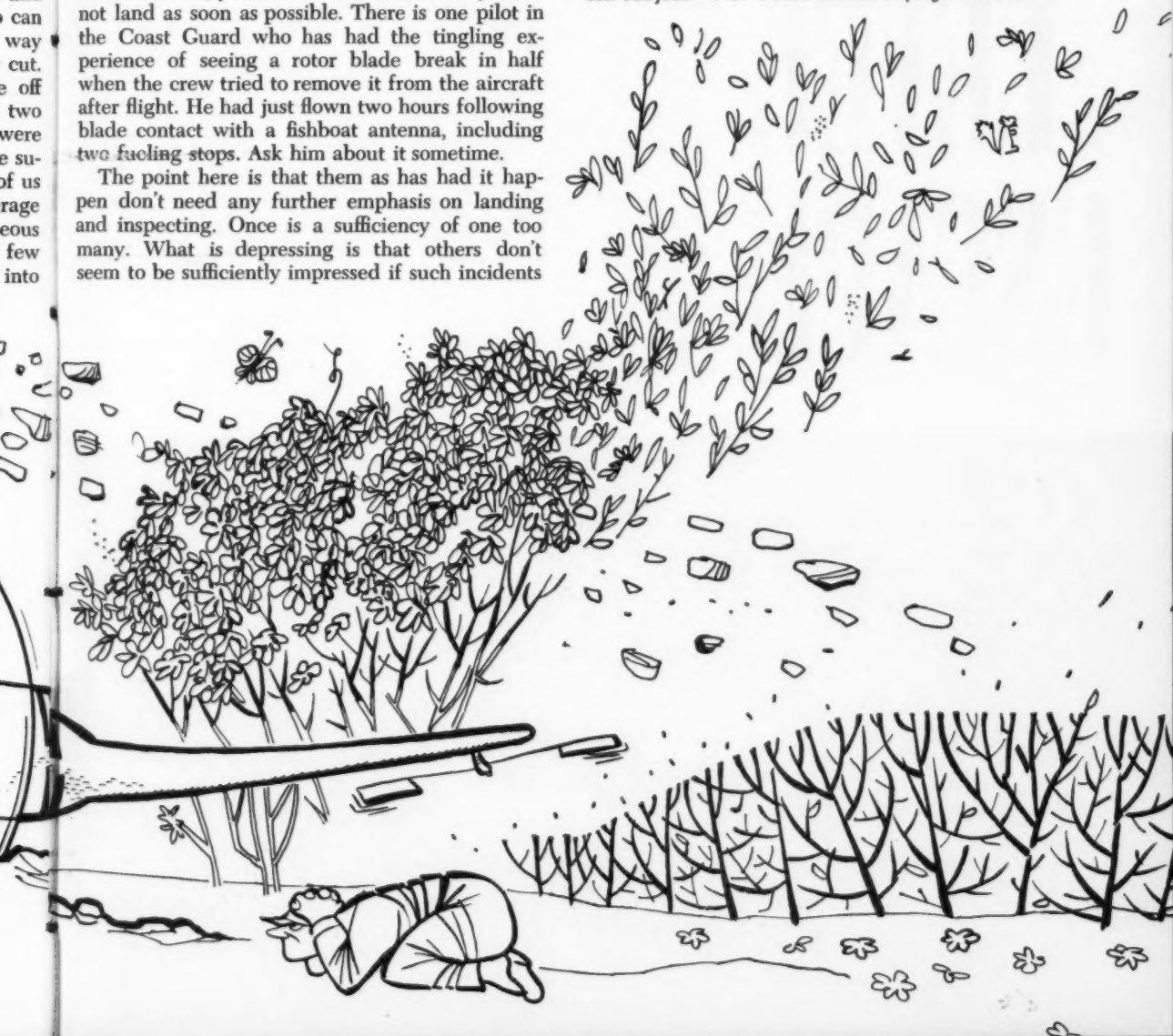


disaster. With a little less luck, there could have been more accidents of this type on the books.

On several occasions in the past, this bulletin has tried to stress the vital importance of landing as soon as possible after sustaining damage or possible damage to inspect the aircraft (anytime rotor blades make contact with anything, you can bet there will be *some* damage). There are times when this has to be ignored, of course, such as in the course of a rescue mission where a human life is at stake, and possibly in combat when the life at stake may be your own. Under any other circumstances, yours is the life at stake if you do not land as soon as possible. There is one pilot in the Coast Guard who has had the tingling experience of seeing a rotor blade break in half when the crew tried to remove it from the aircraft after flight. He had just flown two hours following blade contact with a fishboat antenna, including two fueling stops. Ask him about it sometime.

The point here is that them as has had it happen don't need any further emphasis on landing and inspecting. Once is a sufficiency of one too many. What is depressing is that others don't seem to be sufficiently impressed if such incidents

occur outside their local sphere. Pilot meetings are held to stress the matter at units where such incidents occur, and the unit thus stays alert until new pilots are rotated in or until the fixed-wing specialist who slept through the lecture gets his helicopter qualification. Now, sometimes a pilot just doesn't know he's made contact with an object until discovering damage after flight. And, as stated before, in a vital rescue case, a pilot may judge to accept the risk in order to save life. Other than that, there is no excuse, just as there is no excuse for not heeding the latest warning on an old subject.—U.S. Coast Guard Safety Bulletin



# LOW LEVEL ESCAPE

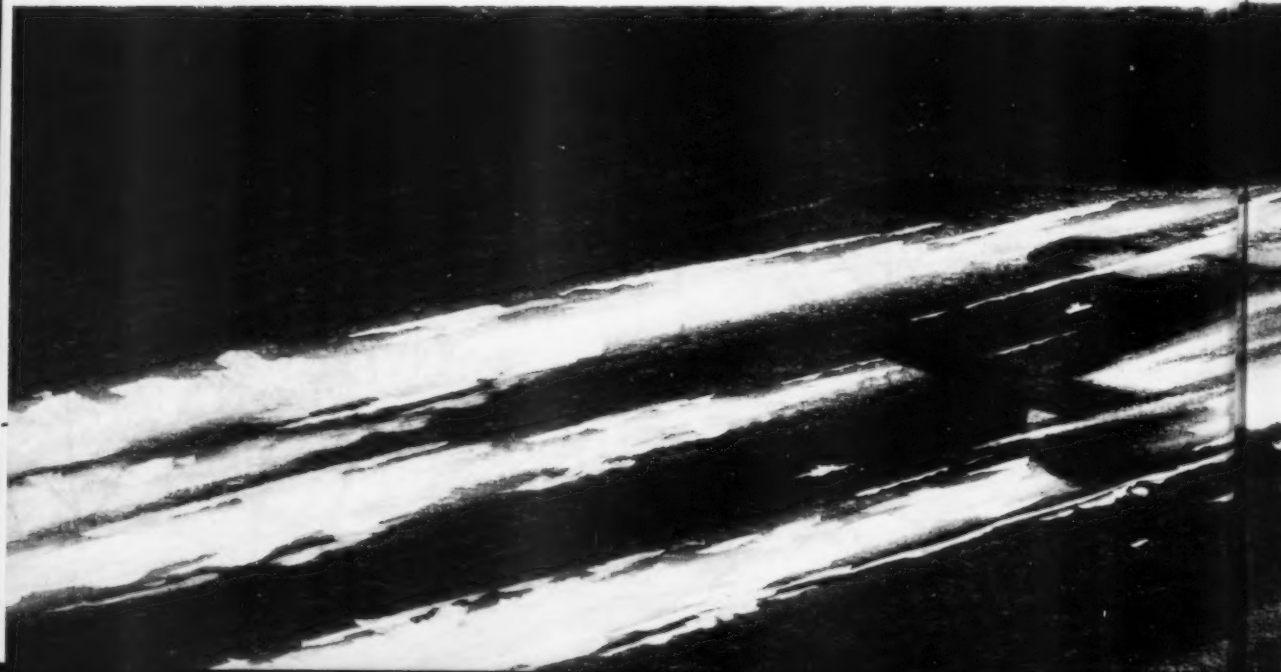
The preflight of the *Crusader* was normal, and I taxied up to the starboard catapult. The first aircraft went up on the cat and had some trouble so they took it off and I taxied on. The hookup was normal and moments later I was shot off.

CCA came up with a turn after I called airborne, but I waited until making sure the gear would come up and the wing would come down. After dirtying up again, I dropped the hook and called turning downwind. CCA said I was close abeam and gave me a 10-degree turn outward. Next was a turn to final bearing. I knew I was close abeam and put in a 30-degree bank turn. I passed over the destroyer with good line up, meatball, . . . I called my fuel state and I believe it was 3000 lbs. About halfway in, everything seemed fine and I continued down the slope. At this time I had about 85-86%. The LSO called for a little power and I added a couple of percent. It

seems like he said "just a little more power," so I added another percent or so. Things seemed good but he called power and I rammed the throttle on. I felt sure I would bolter just about the time I hit the ramp. (*No waveoff was given.*—Ed)

I felt a jolt and knew I'd hit the rounddown. The aircraft continued up the angle and I selected afterburner but didn't feel it ignite. On clearing the deck I pulled back on the stick and started climbing. On hitting the ramp I had lost all communications and therefore didn't know how serious things were until my mirrors lit up with flames and I was able to see the wings were burning. The aircraft just would not seem to develop any power and 200 feet was all the altitude I could get, the airspeed was dropping from 125 to 120.

I pushed myself erect in the seat and pulled my legs together. On pulling the face curtain the curtain came down and I was



holding it in about my lap. I waited and nothing happened. I did not feel the canopy separate on the first pull. Another hard jerk and the seat finally fired. I would estimate the time from when I pulled the curtain to firing was 3-4 seconds. The ride was much smoother than I had expected and as I went out in a forward tumble I saw a blur of fire and thought perhaps the plane had exploded. I did one somersault and ended up with my feet, knees, face, hitting the water about the same time. My reaction was that the chute never opened and on hitting I went about 12-15 feet down. (*The chute was observed to stream but insufficient light precluded sighting the chute blossoming.*)

Salt water came into my mask and I started for the surface. I disconnected the mask and released the upper rocket jet fittings. The chute was wrapped around me and I couldn't kick very well.

I released the lower left rocket

fitting and reached down for the seat pan on the right fitting but it wasn't there. Some time during the ejection I lost it. The lower left fitting was very easy to move and I am not sure whether it was just the strap or not. I blew up the mae west and started trying to untangle the shroud lines from around me. On getting free I turned on my strobe light which blinked about twice and quit. My red flashlight was still attached and I flashed it while getting out a flare. The flare ignited normally burning about 20 seconds. When it went out, I took out my pistol and fired tracer rounds. I could see the destroyer coming my way and I wanted to save the second flare 'till they were closer. I flashed my red light toward the ship and they flashed one back.

About this time they said they were sending a boat over. I took out my next flare as the whaleboat was coming towards me, but it wouldn't ignite. The whaleboat came alongside and

one of the men in the boat had on a skindiving suit. He jumped in and helped push me into the boat.

I was wearing thermal underwear and a summer flight suit and at first felt fine but later the water started getting cold. It seemed as though I was in the water about 20 minutes but I found out when I got aboard the destroyer that it had actually only been about 10 minutes.

(*In this accident the pilot started low and did not report the "meatball."* The LSO advised him he was low and observed him intercept the glide path about 500 yards from the ship. The pilot stated he did not realize he was in trouble until he hit the ramp. Deck lighting on the ESSEX class carrier is such that an illusion of being high is induced. This stems from the convergent deck edge lights and the lack of lights on the number two elevator which gives the impression of a shorter than normal landing area.—Ed) ●



# Counter Pointer

By LCDR BO HEININGER



**F**ight fans, the referee is about to announce the winner of the Navy altimeter championship fight! While we wait for the decision, let us review the background of the contestants and give you a blow by blow description of the fight.

The defending champion is the long familiar three-pointer. Since it became the champion way back before World War II, it has easily defeated all previous challengers. For many years it was the favorite of fight fans, but with the advent of high performance aircraft it suddenly became known as a killer. The ever increasing altitudes at which aircraft were operating had brought into greater use the third pointer, the small hard-to-read pointer which indicated in tens of thousands of feet. Reports of aircraft accidents and near accidents showed that the three-pointer required excessive time to read and was subject to serious and often fatal reading errors.

In 1954, when CNO directed the Chief, Bureau of Aeronautics to reconfigure the altimeters of high performance aircraft to provide improved read-

# er vs Three Pointer

ability, BuAer proceeded with two approaches to comply with this directive. The first was to build up the champion as an interim solution. An improved 10,000-foot pointer and a black and white barber's pole sector, which was visible below 16,000 feet, were installed.

The second approach was to develop a strong new challenger for the championship. Many different altimeter displays were selected for the elimination bouts. After several human factor studies, NADC Johnsville Laboratory tests and NATC Patuxent River and ComOpDevFor flight evaluations, the counter-pointer emerged as the top challenger. One study comparing experienced pilots' ability to read the counter-pointer and three-pointer yielded the following data:

*Counter-Pointer    Three-Pointer*

% Reading errors of		
1000 feet or more	0.7%	11.7%
Average interpretation		
time per reading	1.7 seconds	7.1 seconds

When the championship fight began the coun-

ter-pointer looked like a sure winner. NATC Patuxent River and ComOpDevFor reports stated that nearly all pilots agreed that the counter-pointer presentation was superior. It could be read more quickly and easily, and it virtually eliminated the possibility of a pilot misreading his altitude by 10,000 feet as was possible with the three-pointer. It was also considered superior for determining the release altitude for dive bombing and rocket firing.

It was recommended that the counter-pointer presentation be accepted for use in all Navy aircraft but only after an improvement was obtained in its performance. Some pilots reported that the pointer lagged and jumped excessively as 1000-foot altitudes were passed. So the challenger was sent back to the drawing boards.

The improved performance was not easy to achieve since some pointer lag and jump was inherent in the design of a counter-pointer type instrument. To understand the reason for this requires a brief look at what happens inside



One can endlessly discuss the pros and cons of altimeter presentation. Skip the words for a minute and try the side-by-side comparisons throughout this article.

ARROWS SHOW MOTION FOR INCREASING ALTITUDE. REVERSE FOR DECREASING ALTITUDE.

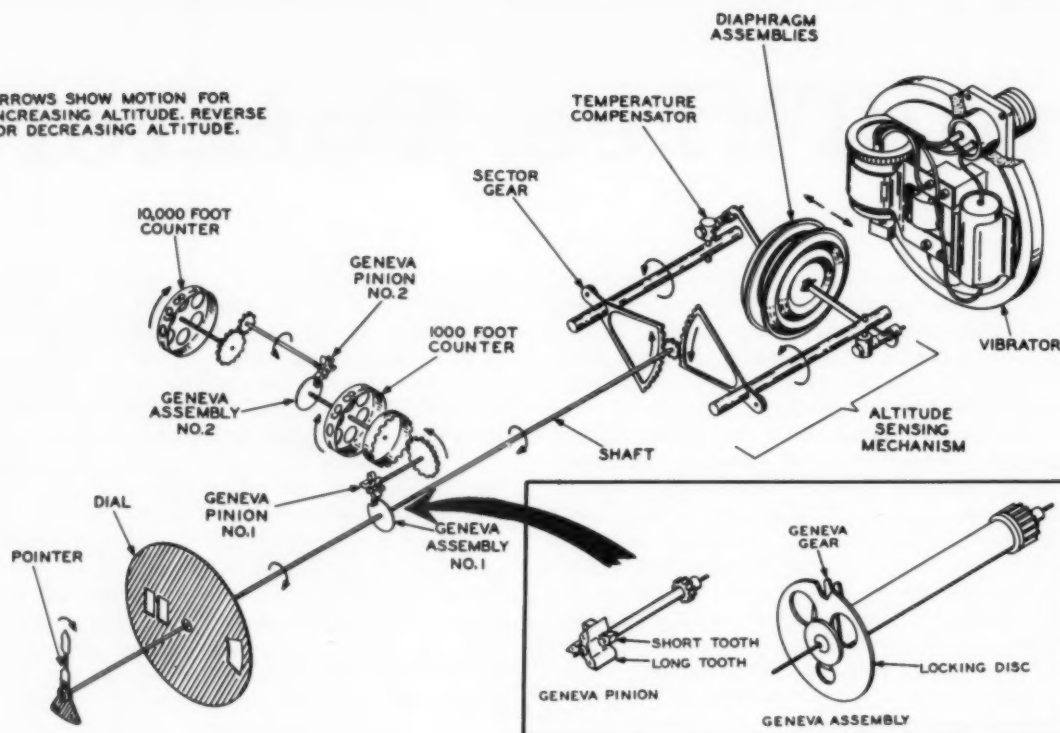


FIG. 1

FIG. 2

14

the instrument case.

Figure 1 is a three-dimensional sketch showing the essential parts of the counter-pointer altimeter. The operation begins when the altitude sensing mechanism reacts to a change in atmospheric pressure. This mechanism, which is essentially the same as that of the three-pointer, utilizes two balanced diaphragms to compensate for the effects of acceleration and vibration. As the altitude increases the diaphragms expand with the decrease in pressure, the sector gears rotate the shaft in a clockwise direction, and the attached pointer makes one complete revolution for each thousand feet of ascent. The first geneva assembly, which is rigidly attached to the shaft, engages the corresponding geneva pinion just as the pointer passes the 9 digit on the outer dial. As the pointer continues to move towards the 12 o'clock position the 1000-foot counter is moved up one digit. This turn over is completed just as the pointer reaches the zero digit. A second geneva assembly is attached to the 1000-foot counter. For each of its complete revolutions the 10,000-foot counter is moved up one digit. See fig. 2.

The action of the geneva mechanism and associated counter and pointer movement can be better understood by studying figure 3. Each photograph shows the counter-pointer dial presentation while the associated sketch shows the corresponding position of the geneva assembly.

Now let us examine the uneven movements of the pointer as 1000-foot altitudes are passed. There are two completely different types of uneven movements and separate causes therefor. Pointer stickiness, a lag and jump movement, is caused by operational friction. Pointer whip, a jump and lag movement, is caused by very rapid changes in altitude.

Operational friction is the term used to describe the various reasons for "sticky" type movements in barometric altimeters. Before the advent of jet aircraft, propeller vibration reduced the effects of operational friction. However, since jet aircraft were relatively free of vibration and they were operated at higher altitudes, operational friction in the altimeters of these aircraft became a serious problem.

In non-servoed barometric altimeters, the sole

moving force behind the whole operation is supplied by the diaphragms. Diaphragms are constructed of very thin, springy metal so that they can expand or contract with minute changes in air pressure.

In the counter-pointer altimeter, it must be appreciated that the operation of the counter is accomplished during only a 100-foot change in altitude. At sea level this change provides a pressure differential on the diaphragms of 0.108

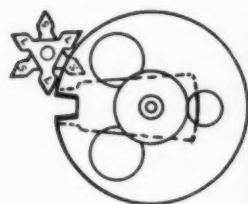


Fig. 3a.—Altimeter reads about 880 feet. The Geneva gear has not yet engaged the geneva pinion gear teeth. The long teeth of the pinion and the zero digit of the thousand-foot counter are safely locked in a position by the locking disc.

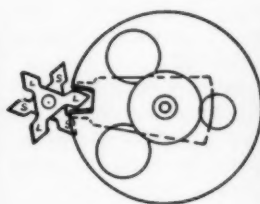


Fig. 3d.—Altimeter shows a reading of 960 feet. The lower forked gear has contacted the lower side of one of the long gear teeth. Approximately 60% of the pinion and 1 digit travel has been completed. Notice how much of the zero digit remains showing in the top of the window.

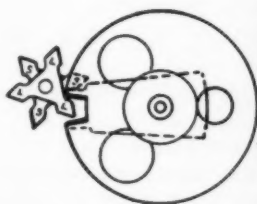


Fig. 3b.—Altimeter reads 920 feet. The upper side of the forked gear has contacted the lower side of one of the short gear teeth and has started the counter turn-over movement. Notice that the 1 digit has moved up slightly in the window.

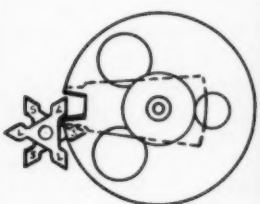


Fig. 3e.—Altimeter shows a reading of 990 feet. The pinion and 1 digit have completed approximately 90% of their travel. (Notice that if we stop the altimeter in this position it is possible to interpret this reading as 1990 feet instead of 990 feet. The possibility of this type of misreading is discussed in detail in this article.)

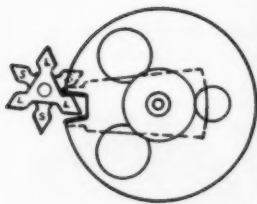


Fig. 3c.—Altimeter reads 940 feet, and the pinion and 1 digit have completed approximately 40% of the travel for the counter turn-over movement.

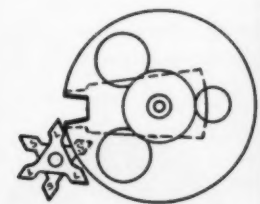


Fig. 3f.—Altimeter reads 1020 feet. The forked gear has disengaged the pinion teeth. The long teeth and the 1 digit are safely locked in position by the locking disc until the next counter turn-over is scheduled.

inches of mercury. At 50,000 feet the pressure differential is 0.016 inches, i.e., only about one-seventh that at sea level. Each time the geneva elements engage, the diaphragms must provide additional force to overcome the load of the geneva and counter mechanisms. All motion within the altimeter momentarily slows down until sufficient force is built up to turn the counters. This accounts for the counter lag.

When the geneva elements disengage, the extra load is suddenly removed from the diaphragms. The diaphragms then quickly adjust to the existing atmospheric pressure causing the pointer to jump slightly.

Pointer lag and jump varies with altitude and rate of change in altitude. It is more pronounced at higher altitudes where the atmospheric pressures are smaller. It is also greater during slower changes in altitude because of the smaller rates of pressure change.

Reed type vibrators were installed in the original counter-pointers to reduce the effects of operational friction. These vibrators reduced the amount of pointer lag and jump to acceptable amounts and smoothed out the pointer movement.

The second type of uneven pointer movement, pointer whip, occurs only during very rapid changes in altitude. The rapid removal of the geneva mechanism load from the diaphragms causes the pointer to overshoot slightly and then hesitate until the diaphragms catch up. Although this movement may be annoying to the pilot who may be concentrating his eyes on the pointer, it should be overlooked, since during these rapid changes in altitudes the more valuable information, the altitude in thousands of feet, can be determined by a quick glance at the counters.

Now that we have briefly studied the theory of counter-pointer operation, let us return to the description of the flight.

Some improvement in the performance was achieved, and in 1958 counter-pointers were in-

stalled in many fleet aircraft. Some pilots were enthusiastic about the counter-pointer; others were very reluctant to give up the old familiar three-pointer. Many complained about uneven movement and excessive lag and jump of the pointer as the counters changed. The reed type vibrator was not considered reliable since it was susceptible to voltage and frequency fluctuations of aircraft electrical systems.

In 1959, all counter-pointers were removed from Navy aircraft and were returned to the manufacturer for modification. A motor driven vibrator was installed, but evaluation showed that it could not always be depended on to start. An improved motor driven vibrator was then designed and evaluated. It proved very reliable and established a 1000 hour MTBF (Mean Time Between Failure). This type vibrator was then installed in all counter-pointers. Improved performance was also obtained through adoption of many new techniques, some of which are listed as follows:

- Ultra-sonic cleaning of components.
- Instrument assembly in clean, dust free areas.
- Inspection under 20-power binocular microscopes.
- Precise matching of diaphragm pairs.
- Requirement for a four micro-inch polished finish on the geneva pinion.
- More precise balancing of critical rotating components.
- Greater use of jewelled bearings and polished pivots.
- Greater use of very light material.

New rigid friction tests were also established. Each altimeter was required to pass five consecutive friction tests before it was accepted by the Navy. The following tolerances of pointer lag and jump with the vibrator operating were the maximum allowed:



Altitude	Rate of Ascent or Descent	Lag or Jump
0 — 12M	500 fpm	25 feet
12 — 50M	3000 fpm	25 feet
50 — 60M	3000 fpm	50 feet
60 — 80M	3000 fpm	50 — 100 feet

A 25 to 50 foot lag or jump at normal operating altitudes was considered to be acceptable with the vibrator operating. But what would happen if the vibrator quit in flight? Could the pilot safely make an instrument approach? Each altimeter was also required to pass five additional consecutive friction tests with the vibrator inoperative. The maximum allowable pointer lag and jump varied between 300 feet at lower altitudes to 1250 feet at 50,000 feet.

NADC Johnsville and NATC Patuxent River evaluated the modified counter-pointers and recommended that they be reinstalled in all high performance jet aircraft. NATC reported that the counter-pointer was satisfactory for instrument flight even with an inoperative vibrator, but that flight under those conditions was not too desirable.

At this point it is emphasized that a pilot can determine if the vibrator is operating by merely placing his fingers on the instrument dial cover and feeling the vibration. If he does not feel vibration he could anticipate increased pointer lag and jump as each 1000-foot altitude is passed. If the pointer does tend to stick, a slight tap on the instrument should free it.

In 1961, counter-pointers were reinstalled in fleet aircraft. Their performance and reliability showed considerable improvement. A recent analysis by the Naval Air Technical Services Facility, Philadelphia, of all FUR (Failure, Unsatisfactory, or Removal) Reports shows that the reliability of the counter-pointer has reached that of the three-pointer.

Reports indicate that some pilots still complain about the counter-pointer. They consider the pos-

sibility of misreading it by 1000 feet is more dangerous than that of misreading the three-pointer by either 1000 or 10,000 feet. It is interesting to note that there are two completely different causes for possible 1000-foot misreading of the counter-pointer. The first can occur during high rates of descent just as the counter changes, and the pilot fails to add the value of the pointer reading to the value of the reading on the counter. For instance, the pilot sees the counter change from 12 to 11 and immediately thinks his altitude is 11,000 feet whereas it is actually 11,900 feet. It is reported that this confusion happens only during initial flights and rapidly disappears as experience with the display is gained.

The cause for the other type of possible misreading is very important and should be thoroughly understood. An area of ambiguity can exist at all altitudes whenever the pointer is between a 950 and 1000-foot position. Notice figures 3(d) and 3(e). It is possible for the pilot to interpret these readings as 1960 and 1990 feet instead of 960 and 990 feet if the change in altitude is stopped.

Now before this instrument is condemned without its receiving an honest evaluation, one must carefully consider under what conditions this ambiguity can occur and how easily it can be handled.

First, this ambiguity can occur only during either level flight or very small rates of climb or descent. During higher rates of climb or descent the counter turn over is so rapid that the area of ambiguity is not noticed. Second, this ambiguity can occur only for approximately 5% of the total possible readings of the altimeter. The chances of its occurring are further reduced by the action of the two digits in the window during the turnover.

The following two simple rules to follow in using the counter-pointer are recommended:

**RULE 1.** Track the altimeter carefully prior to leveling out at any thousand-foot altitude.<sup>1</sup>

**RULE 2.** If the pointer lies between a 950 and 1000-foot position after leveling out, increase or decrease altitude slightly until the pointer moves out of the ambiguous region. Normally an in-



1—U.S. FLIP Pilot Procedure Enroute, p II-8, para. III B.1 states "When cleared by ATC . . . CLIMB rapidly to within 1000 feet below the assigned altitude/flight level, or descend . . . rapidly . . . to within 1000 feet above the assigned altitude/flight level, as applicable, and then not to exceed 500 feet per minute until the assigned altitude/flight level is reached."



LCDR Bo HEININGER graduated from the Naval Academy, Class of '47, and served in destroyers for two years. Completed flight training in '50. VP-7 for 4 years and qualified PPC in P2 (P2V) aircraft. VR-7 for 3 years and qualified MATS Aircraft Commander in C-121 (R7V) Aircraft. Completed CIC School, Electronics Material School, T.I., and Electronics Maintenance School, Great Lakes. Electronics Instructor at U.S.-N.A. for 2 years and qualified Aircraft Commander in HU-16 (UF) Aircraft. Attached to Staff, ComFAirWing SIX, for 2½ years as Asst. OPS, AVSAFE, and ECM Officer. Reported to Instrumentation Branch, Avionics Division in BuWeps in July '62 as project engineer on aircraft instrumentation mockups, barometric altimeters, and electronic cockpit displays including the contact analog pathway-in-the-sky roster scan vertical display.

crease would be preferable so that the counter numbers will reflect the actual altitude in thousands of feet.

Listen fight fans, the referee is announcing the winner of this championship fight!

**"THE FIGHT IS A DRAW!"**

The counter-pointer is authorized for installation in all high performance Navy jet aircraft. Aircraft service changes have been issued authorizing reinstallation of the counter-pointers in the A-3 (A3D), A-4 (A4D), F-3 (F3H), F-8 (F8U), F-9 (F9F), F-11 (F11F), F-1E/AF-1E (FJ-4/4B), T-2 (T2J), and T-1A (T2V) aircraft. All new production jet aircraft, A-5 (A3J), A-6A (A2F), F-4 (F4H), T-39D (T3J), and F-111 (TFX), will have counter-pointers installed. The altitude ceilings of these aircraft are such that the aircraft can be operating in one of several 10,000-foot increments, and the pilot in a high rate of climb or descent may not always be aware of which increment the aircraft is in. Therefore, he needs an instrument which can tell him *at a glance* what his altitude is. The counter-pointer does exactly this!

The three-pointer will continue to be installed in all helicopters, propeller and turbo-prop driven aircraft. These aircraft usually have two pilots and two altimeters, and the aircraft ceilings are such that pilots are generally aware of the 10,000-foot altitude increment in which they are operating without having to read the third pointer.

The Bureau of Naval Weapons is continuing its efforts to develop a superior altimeter display, one which can be used in *all* Navy aircraft. NATC Patuxent River, Maryland has evaluated nearly every altimeter that has been developed. These include variations of the three-pointer, drum-pointer, combination 5 digit read-outs and rate-of-climb, and vertical tape displays. None of these have been reported as superior to the counter-

pointer in *both* readability and performance.

In summary, the counter-pointer is preferred over the three-pointer for installation in high performance jet aircraft because of its improved readability and lack of 10,000-foot ambiguity. The past problems of the counter-pointer have been the interpretation of normal pointer lag and jump as a malfunction and the possibility of misreading the display by 1000 feet. Considerable effort and money have been devoted to improving the reliability and performance of the counter-pointer. More emphasis is now being placed on familiarizing flight personnel with the display and theory of operation. This article was written to provide increased understanding. OpNav and BuWeps have also recently approved production of a short training film showing the operation and use of both the counter-pointer and three-pointer altimeters.

To those of you who do not like the counter-pointer, you are challenged to give it another chance, forget about its past history of poor performance, give it a clean bill of health, and learn to use it to your advantage. Even though you may prefer the three-pointer and feel that you perform better with it, there is considerable proof that the majority of jet pilots perform better with the counter-pointer. Undoubtedly, you will see counter-pointers that do not perform satisfactorily. These instruments must be replaced, reported on FURs and returned to overhaul and repair activities for repair and modifications.

To those of you who will fly only helicopters and propeller and turbo-prop driven fixed wing aircraft, you will not have to give up the familiar three-pointer until a more superior display is developed, evaluated and accepted.

Regardless of which altimeter you will use, counter-pointer or three-pointer,

**KNOW IT BETTER AND USE IT SAFELY ●**



## SHOCK STORY

**O**n the afternoon of 25 April 1963 this Anymouse took off from NAS Alameda enroute to NAS Lemoore. The weather was 3000 ft. overcast in rain showers with scattered thunderstorm activity in the mountains to the East.

Departure control radar picked me up after takeoff and began vectoring me to the southeast on a steady climb. I entered the clouds around 3000 ft. and because of the darkness I had my visor up and red instrument lights ON full.

At about 4500 ft. my aircraft was suddenly enveloped by a brilliant flash that was sustained for 2 to 3 seconds, and accom-

panied by a severe jolt to the airframe. I was momentarily blinded by the flash, and the impact was so great that my first conclusion was that I had collided with another aircraft. After a few seconds of stunned immobility I realized that I was still flying and a quick check of the instruments showed that everything was in order and the aircraft was climbing. Then I noticed two burned areas about four inches in diameter on the inflight refueling probe which caused me to believe that the aircraft had been struck by lightning. There was no other apparent damage so I continued to NAS Lemoore where I downed

the aircraft for a check.

It was found that the systems were okay and damage to the airframe amounted to numerous burn spots on the inflight refueling probe, one small arc weld on the vertical stabilizer and two melted, warped wingtip lights with blown bulbs. And, of course, one slightly rattled aviator.

This incident is submitted for information purposes so that aviators may be aware of the fact that lightning can strike an aircraft and while it may not necessarily be serious it certainly can be startling.

19



The purpose of Anymouse (anonymous) Reports is to help prevent or overcome dangerous situations. They are submitted by Naval and Marine Corps aviation personnel who have had hazardous or unsafe aviation experiences. As the name indicates these reports need not be signed. Forms for writing Anymouse Reports and mailing envelopes are available in ready-rooms and line shacks. All reports are considered for appropriate action.

— REPORT AN INCIDENT, PREVENT AN ACCIDENT —

approach/august 1963

## Booby Trap

Upon completion of final FMLP landing on runway 8L at El Centro, the pilot let his S-2 (S2F) decelerate and prepared to clear the runway to the right.

The plane was not based at El Centro and all radio frequencies had to be manually dialed in. As the aircraft turned off the runway, the plane commander, riding as copilot, commenced changing over to ground control.

Almost immediately after clearing the duty, the pilot stopped the aircraft. It wasn't soon enough. A C-130 (GV) making a touch-and-go landing on runway 8R executed a late waveoff to avoid the taxiing S-2 (S2F).

We have heard many times that parallel runways or dual runways are necessary to expedite traffic safely. But if you don't think ahead they can be a booby (meaning dumb bird) trap.

## Look Ma, No Hands

As no. 3 man in a flight of three SH-3As (HSS-2) we had anchored overhead a DD and were waiting for our exercise to begin. Before too long the controlling ship gave us a vector to our exercise sub and the three of us set out at "gate speed" to investigate.

This ole Anymouse was trailing a little behind but gaining steadily. My copilot had copied all the pertinent info and was placidly awaiting our arrival in the contact area. I decided to look at the data which the copilot had conveniently placed on the center console. Without a second thought I took my hand

off the cyclic and as I did so the cyclic went to the forward position so rapidly that negative G-force was encountered, placing our helo in a nose down position with the water only 500 feet below.

Immediately I grabbed for a handful of cyclic and managed to punch off the ASE which added to the erratic behavior of our helo. I heard the rotor blades hit the forward droop stops and instinctively I yanked back on the cyclic and hit the rear droop stops! For a minute I thought I had chopped off the tail rotor drive shaft.

My poor copilot just sat thru all of this with mouth agape because the entire evolution had happened so fast. The hairy part is that we lost 200 to 220 feet in getting the helo under control again.

We analyzed our problem to have been a sticking trim release button. It has happened once before to this Anymouse while sitting on the deck of a CVS. Our maintenance department is aware of the problem and is seeking a satisfactory remedy. As for me, I'm going to break the habit of taking my hand off the cyclic stick.



approach/august 1963

## Low Oil

After a long weekend, the morning launch manned aircraft and took off on a routine bombing hop. Shortly after take-off, the SDO was notified that one of the A-4s (A4D) was diverting to a nearby field because of low oil pressure. After it was learned the aircraft landed successfully, the SDO was notified that another one was making a precautionary approach at home field with no oil pressure. This one also landed safely.

The diverting aircraft was found to be nine quarts low on oil and no leaks were found on turnup. The one landing at home base was eight and a half quarts low and no leak was found during high power turnup. It was perplexing because each plane captain stated that the oil tank was full when the aircraft was preflighted. However, this could not have been possible since the oil would have drained down into the reservoir over the weekend and no indication would have been present until after turnup.

It was found that the plane captains did not know how to properly determine if oil was in the aircraft. In the A-4 the normal cohesion forces of the oil will cause the strainer to appear to have oil present when empty and it is squadron procedure to check the oil level after turn-up, but the man designated to do this failed to check these two aircraft. Other planes in the flight which were checked all needed oil and had it added.

Two slipped by.

Since one of the pilots involved was the Line Officer a review in plane captain qualifications and emphasis on safety checks has been carried out.

## Count The Odds

After completing a normal start of an F-8C (F8U-2) aboard ship, I commenced completing a series of ground checks required prior to flight. With the wing down I wiped out the cockpit with the control stick and noted no discrepancies. After raising the wing and again wiping out the cockpit, I noticed I could only throw the stick about halfway to the left. The stick remained in the position when released.

Contrary to procedures I forced the stick free. Thereafter I could not duplicate the trouble though I cycled the wing up and down and wiped out the cockpit numerous times.

Discretion being the better part of valor, I downed the aircraft and missed the launch. The cause of the frozen stick was found almost immediately. When the "Buick Hood" (equipment compartment access door, CV-420087-007), was opened the after stay assembly (CV-15-410164-10), was found to be free from the spring retaining clip. Gouge marks were found on the aileron bellcrank and the stay assembly rod.

From this evidence it was concluded that this was the cause of the jammed controls. When this rod is not in place, the free end is in the vicinity of the idler arm and bellcrank and, as in this case, can jam the controls. The spring clip in this case was weak and could have allowed the stay rod to fall free if the Buick Hood was slammed out.

The forward stay assembly has a locking pin feature that would preclude this type of occurrence. Could a locking pin be installed on the after stay as-

sembly?

I shudder to think of what would have happened if the rod had waited for the cat shot before jamming the controls. This may have been a one-in-a-thousand type of occurrence, but that wouldn't have helped me.

## 1-2, Skiddoo!

As part of my introduction to the A-4 (A4D) I was scheduled for a taxi hop. My fam instructor took me through a blindfold cockpit check, monitored my start then shoved me off. I was to contact ground control and ask for an off-duty runway for taxi practice and aborted takeoff runs (traffic permitting).

Ground control directed me to runway 22, to hold short as another A-4 was making an aborted takeoff in the opposite direction. After the other aircraft passed I went on the runway, ran up to 85 percent, released brakes and went to full power.

At about 90 knots I pulled the power back to idle and lifted the flaps as there was a slight crosswind. All was normal. I turned off the other end and waited about 5 minutes for the other aircraft to complete his second aborted takeoff.

I went back on the runway but this time the wind was a downwind component. I followed the same procedure as before; however, this time when the brakes were applied there was little response. Pumping them brought up the right one but the left did not hold. I headed for the edge of the runway.

Just before going off the edge I managed to get it straightened out but couldn't get back to the center of the runway and figured

there was no chance of taking the gear at the end. At this point I shut the engine down.

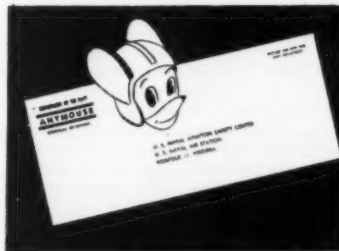
As I passed the turnoff I tried to make the corner but the right brake would not hold and I coasted off the end, tearing down a threshold light with my drop tank. There was no apparent damage to the aircraft but 5 minutes later one tire blew and 2 minutes after that the other one let go.

## Care with Handle

The A-1A (A1D-6) had been AOCP three days down in hangar bay three. During this time the oxygen regulator was changed which required raising the gear handle. When I got in the aircraft, I was asked to raise the tail hook as it was resting on no. 3 elevator and it needed to be lowered.

I switched to BATTERY ONLY, ran up the hydraulic pressure and raised the hook. While doing this I noticed the starboard gear indicator flop to barber pole. Then I noticed the gear handle UP. I pushed the handle down and started the engine. As hydraulic pressure rose, I felt a thud as the starboard gear locked down. At the same time the indicator flopped to down-and-locked.

A close one!?!?





22

Dear Headmouse:

We've got boxes of whistles that won't whistle. It's a hell of a mess, I'd say. Picture yourself as a Naval Aviator down at sea on a dark night and there goes the Rescue Destroyer sailing by, and the damn whistle won't work—BARF!!

I suggest you close your eyes and try blowing on this whistle as hard as you can to achieve that effect. May I also suggest you hire a big lipped sweetheart with large lungs as a whistle tester before you ship any more whistles out of the plant.

I know that it can be blown but the criticality of the embrochure and lung pressure leave too much to be desired in a survival situation.

Even our line sentries don't like this whistle.

ANYMOUSE  
FIGHTER PILOT

►The manufacturer states:

We cannot understand the complaint of the writer of referenced letter, as the enclosed sample blows perfectly. All whistles manufactured under our contract were subjected to environmental, humidity, water pressure, deep-freezing and drop tests, and, last but not least, to blow testing. No failures were found and all whistles shipped were approved by Government inspectors.

You will note that sample whistle contains a cork ball. Complainant may

be suffering from a case of a stuck ball.

Apparently, naval aviators have small lung capacities these days, for we accosted a four-year-old boy on the street in front of our plant, and he had no difficulty whatsoever in blowing sample whistle. Incidentally, the tone is B-flat.

P.S. We also supply these whistles in yellow, white, red, blue and blushing pink. May we be of service?

Very resp'y,

*Headmouse*

### Butterfingers

Dear Headmouse:

Enclosed picture depicts a peg-board test to measure the loss of dexterity in a pressurized suit. In one test, the loss was nearly 80 percent compared to his dexterity without gloves. This test is to help engineers to improve their designs of future equipment for astronauts and their space stations.

I wonder if this might be a good test to subject Navy flight gloves to (wet, of course) in the hope of improving present equipment for today's aviators.

ANYMOUSE

approach/august 1963



►Headmouse understands BuWeps has sent out a limited number of silicon resin coated gloves for evaluation. It is hoped this will eliminate the slipperiness associated with wet flight gloves which can be disastrous when trying to unlatch a cantankerous rocket jet fitting while in the water.

Very resp'y,

*Headmouse*

## Point of View

Dear Headmouse:

Here's a tech rep's report we've gotten a chuckle over. Thought you might, too.—*Anymouse*

► Naval aviation in general and aircraft carrier operations in particular is a study in classical aviation safety effrontery. General aviation safety rules are numerous and well known and include such "don'ts" as: 1.) Don't fly over large bodies of water without check points. 2.) Don't land and takeoff from fields of scant dimension. 3.) Don't lift the plane from the runway until a safe margin of flying speed is reached. 4.) Don't make power-on approaches unless absolutely necessary. 5.) Don't try to land on the numbers. 6.) Don't taxi too close to other aircraft, buildings, cliff edges or people. 7.) Don't taxi too fast. 8.) Don't walk near a propeller. 9.) Don't walk near a jet intake. 10.) Don't walk near a jet exhaust. 11.) Don't fuel an aircraft while the engine is running. 12.) Don't fly the aircraft that has just performed a major stressing maneuver (trap) without a complete inspection. 13.) Don't, don't,—etc. After watching the goings and comings of a carrier operation for ten days I can only conclude that

some time back an early naval aeronaut received these rules from a USAAF pilot who had blacked out all of the "don'ts" in the fond hope that eventually his Navy air power competition would eliminate itself. But to the contrary it seems as if the Navy pilot has thrived on this diet of calculated madness as if it were an elixir to prolong life instead of like living under the sword of Damocles. It is to the everlasting credit of the people involved that they can function with such efficiency and outstanding teamwork in an environment that strains man and machine to just under their yield points.

Consider for a moment that in the space of a few minutes after boarding an aircraft the crew and aircraft are whisked to the flight deck on an elevator, started in a wind blown cacophonous frenzy of other aircraft who are landing and stretching a one and one-half inch steel cable like a sling shot a scant wingspan away, taxied at 50 knots IAS to a catapult where the preceding aircraft conveniently belches its exhaust directly into your intake ducts, strapped securely to the crankshaft of a steam engine with two 18-inch diameter pistons and a stroke

of 250 feet, literally shot down the deck from 0 to 130 knots IAS as if from a giant crossbow, use the two mile racetrack pattern as a convenient lull to let the eyeballs return from their short study of the underside of the cranium and the bladder to assume its normal shape (the RIO also indulges in a little amphalo scepsis on his lack of sufficient reasons for being where he is), diligently center the "meatball" on the landing system mirror while at the same time defying the ship to impede your consummate skill and power by carrying 90%, land with a bone jarring crunch that bottoms everything on the aircraft and though anticipating a deceleration the throttles are two-blocked full forward (sort of like approaching a yellow traffic signal with an automobile and simultaneously applying full brake and gas pedals), whisper some delirious comment to the other damoclean crew member because the shoulder harness held true (those whose shoulder harnesses have been loose on landing can easily be recognized by the step functions in their physiognomy), taxi frantically from the impact area to whatever fate the operations officer has next in store. ●

## Said Tom...

Now that the knock-knock craze has run the gamut, the Tom Swifty fad seems to have taken hold. A few aviation oriented missiles have crossed our desks. Here's a sampling—please send us yours.

*"My record for cat shots has been almost perfect," said the cat officer coldly.*

*"I've never seen static discharges," said the JP fuel truck driver groundlessly.*

*"He looked good when he went by here," said the LSO cantedly.*

*"This part will go on either way," said Murphy lawlessly.*

*"We got the contract," said the general dynami- cally.—"Time"*

*"I thought the NC-5 was in NEUTRAL," said MUGS shiftlessly.*

*"The compressor stall didn't bother me, but the ejection seat refused to work," said the hot rock overheatedly.*

*"I thought the gear was down," said the pilot absentmindedly.*

*"Yes, I know how the varicam works," said the Neptune pilot porpoiselessly.*

*"I knew the gear handle was down," said the CDR uppedly.*

*"I'm getting fat," said the Class IV type heavily.*

*"Turbulence is not good for you," said the Air Boss thunderingly.*

*"There goes another pair of wings," said the pilot testily.*

Have you a question? Send it to Headmouse, U.S. Naval Aviation Safety Center, Norfolk 11, Virginia.

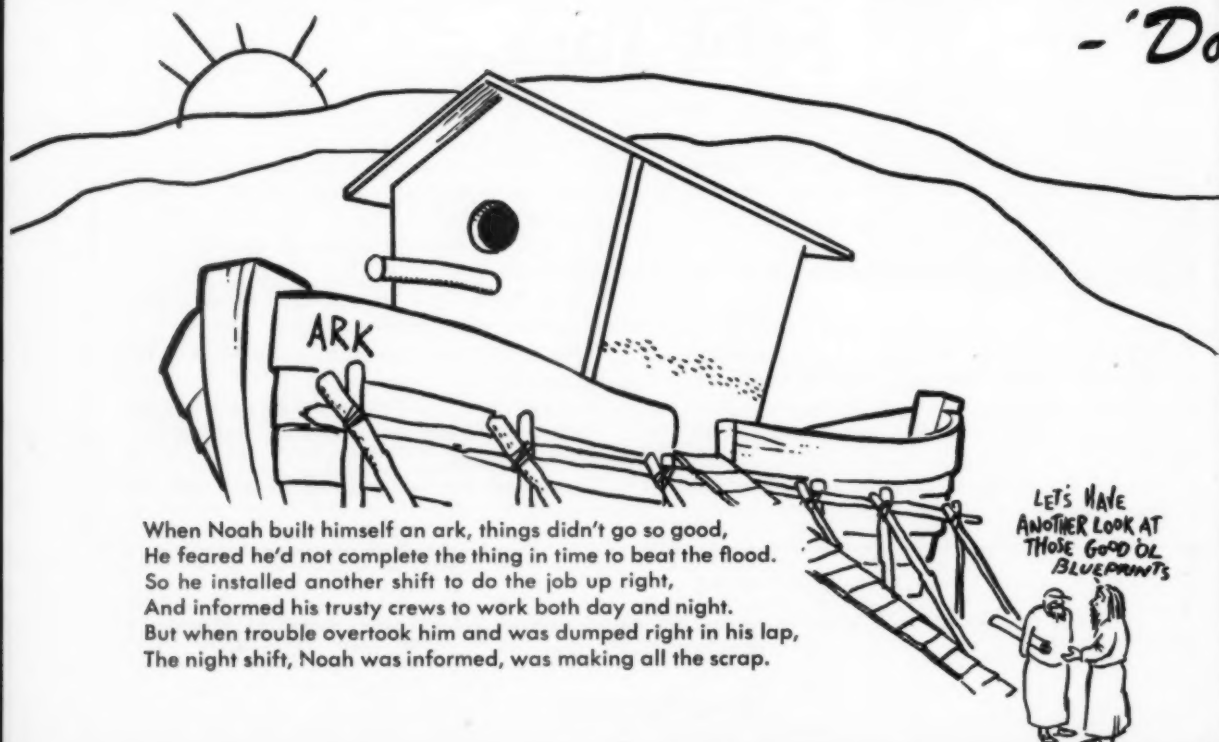
He'll do his best to help.

approach/august 1963



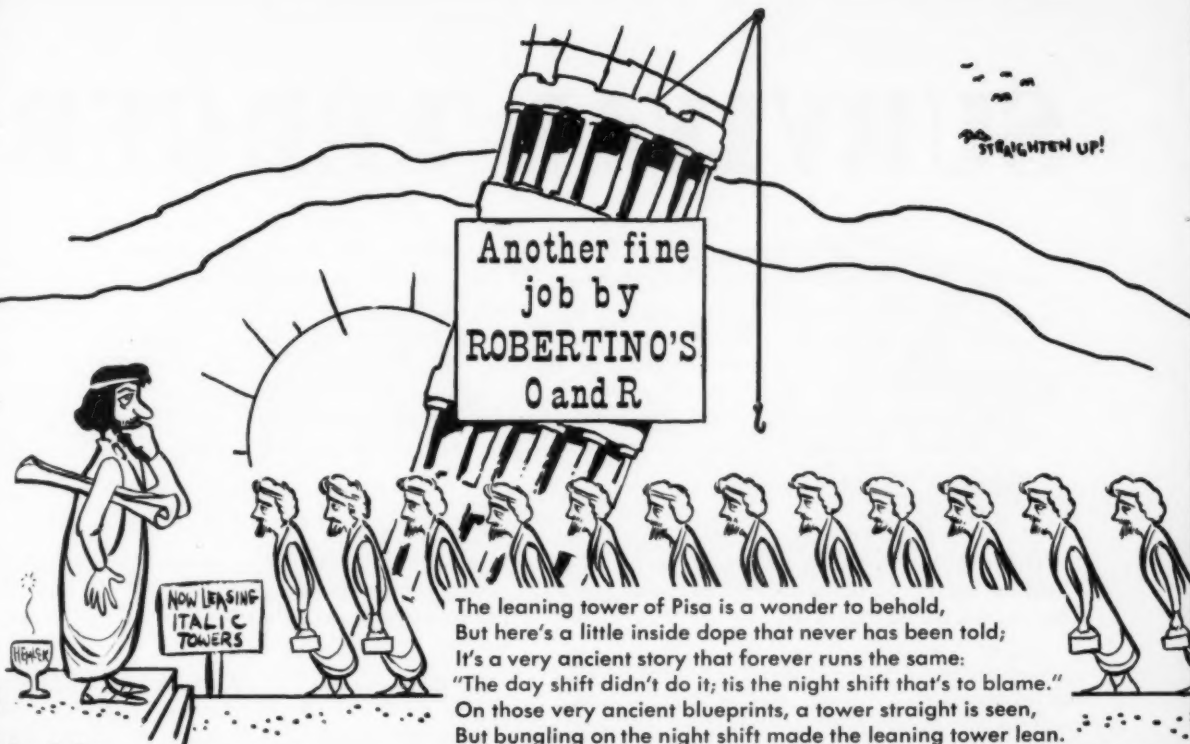
When Cheops built his pyramid of mortar, stone and brick,  
He thought he'd put a night shift on and do the job up quick.  
But government inspectors found a lot of work unsound  
And called the superintendent in to show him what they found.  
The big boss looked upon the scrap and grief was in his gaze,  
He sadly shook his head and said, "We don't do that on days."

The  
Other  
- 'Doe?



When Noah built himself an ark, things didn't go so good,  
He feared he'd not complete the thing in time to beat the flood.  
So he installed another shift to do the job up right,  
And informed his trusty crews to work both day and night.  
But when trouble overtook him and was dumped right in his lap,  
The night shift, Noah was informed, was making all the scrap.

# The eShift Do It!



# SURVIVAL LEDGER

In a spin at approximately 20,000', after compressor stalls and a flame-out, a jet pilot on a daylight flight pulled the face curtain with one hand and ejected. The automatic ejection equipment functioned as designed and he was on his way. During parachute opening he experienced what he described as "an extreme amount of twisting of his back which almost seemed like elongating it." As the pilot in his parachute descent breaks out of the weather at about 4000 feet, let's set up a survival ledger on his actions as well as factors beyond his control—debits and credits—to figure the final outcome. . . .

**Debit** —During descent the parachute risers held my head in an uncomfortable position. I took my helmet off and let it go.

**Credit** —*I got ready for the landing in the water . . . checked my shroud cutter to make sure it was in place . . . released the left lower rocket jet fitting and the seat pan dropped to my right side. Reached down, got hold of the lanyard and hooked it up under my Mk-3C life preserver. Reached up and placed both hands on the rocket jet fittings so as soon as my feet hit the water I could shed the parachute.*

**Debit** —When I hit the water I squeezed and pulled down the jet fittings and neither one released. (This was an isolated case of error. Investigation showed that the rest of the squadron knew to "squeeze and push up" to release the fittings.—Ed.) I went under the water with the chute. The chute dragged me through the water for 15 to 20 feet. I was taking a lot of salt water. The risers not releasing bothered me more than anything. I had experienced this before in the swimming pool — those risers not releasing. I went under the water, opened my eyes and took a look. I could see that I was now closing on the chute and I could see all those shroud lines.

**Credit** —*I got the shroud cutter out with no difficulty at all and I took one swipe at the shrouds, but . . . I found out that you have to hold on to the shrouds with both ends in order to cut. You can't just slash away at them in the water because you don't have any pressure on the shrouds. I cut a couple of these and this looked like a real slow process so I inflated the Mk-3C life preserver which surfaced me.*

**Debit** —I wasn't having any luck getting rid of the rocket jet fittings and I could already feel the pressure of the parachute indicating that it was starting to pull me under so . . .

**Credit** —*I took the lanyard to the life raft and pulled it out. It was the longest lanyard I have ever seen in my life. I pulled it all out and inflated the life raft. I got in the raft immediately with the shroud lines still on and the parachute harness hooked because I felt that I had a better chance of staying above water that way. When I threw myself into the raft I got the pressure off the risers and they released with no difficulty whatsoever. I had a couple of shrouds wrapped around me which I cut at various places to make sure the chute floated clear. I was in a good raft with an inflated Mk-3C life preserver, and torso harness and anti-G suit.*





**Debit** — It was raining, the seas were rough and I would venture to say we had about 20 knots of wind out there . . .

**Credit** — I sat tight in my raft with my Mk-3C life preserver wedged down under the corner of the raft on the large side for about an hour. I waited for the pain to subside in my back which it wasn't going to do. All this equipment was hanging on me and I was absolutely immobile so . . .

**Debit** — I decided the best thing to do was to get rid of that torso harness and anti-G suit so I would have some way to move around inside the raft. I dropped my oxygen mask and regulator over the side. It took a considerable length of time to unhook the Mk-3C and weave it out between the various fittings in the back of the torso harness. Though I was concerned about using the knife inside the raft for fear I would punch a hole in it, on a couple of occasions I used the knife to cut through strapping . . .

**Credit** — I snapped the Mk-3C around my chest. I had a dry SEEK 1 and 2 from which I used the lip ice. The emergency survival kit was in the raft with me. This takes up a lot of room so I opened it up, took out a few items—the radio, mirror and solar still. I zipped up the kit and with the lanyard that was on the kit attached to the raft, just placed it in the water. I used the signal

mirror when the sun was out. It was hard to hold the mirror on a point due to the motion of the raft, but I could play the beam on the horizon.

**Debit** — Now I had a little more room to work and to get the anti-G suit and torso harness off. After I got them off, I inflated the anti-G suit orally and released it in the water so that at least if it was found SAR would know that I had survived the bailout and was somewhere in the area. I reached back to pull in the survival kit and it was gone. It had come loose somehow . . . Now I had only the .38 revolver and the two flares on my life preserver.

To the south I saw a four-engine aircraft high. Here I think I pulled the error typical of anybody in the water trying to survive—I fired tracers and lit a day flare. As soon as I did, I realized this was a mistake. He was too high and never would have seen me—he wasn't out there to search. At about 1600 I saw a UF to the north, apparently on an east-west course about 14 miles away at 1000'. Once again I made a mistake—I lit a night flare. As soon as I did it I realized that I was now down to one flare and resolved not to do this again.

**Credit** — Shortly after the UF went by, there was a P2V up in the same area going in the opposite direction. He was so far away there was no sense in even firing any tracers so I kept all of my equipment and watched him fly over the horizon.



*It was obvious to me at this time that the air-sea search was on. I knew then that I would not be rescued that night so I settled down . . .*

**Debit** — I checked over what equipment I had left and also the little one-cell flashlight. It had come on as soon as I had hit the water and had burned all night long—I couldn't turn it off. It got dark about 1930 or so. I was experiencing a great deal of trouble keeping the raft upright. I would be half-out and half-in and then there would be a mad scramble to get back in the raft again when it would tip. I had taken off my boots. I had dropped one over the side and lashed the other to the side of the raft. What this boot was doing was acting as a sea anchor. Every time I rode up over the crest of a wave, the boot would dig that side in and I would start to ship more water.

**Credit** — I just took the boot in the raft with me and used it to bail with. I would get the water to a low level, then use the sponge to get the rest out. This went on all night. A little bit of water in the bottom of the raft didn't seem to bother at all; in fact it would pick up body temperature and I was rather comfortable inside the thing except

when I shipped a lot of water. But generally, I was warm that night. I got under the poncho, put it over the top of my head and held it down the middle section of the raft to keep the water out.

Very late at night I stopped moving around and selected the best position that I could so my back wouldn't pain me so much—kind of low in the raft so my feet rested on top of the lower part. I stayed in that position until morning. Once you are over the original pain of a particular position, you become numb and that's how it was. I dozed off and on through the night.

**Debit** — I fired a few tracer rounds when I thought I saw lights and that was just ridiculous too. I stopped firing the tracers—I don't think I had more than three or four left.

**Credit** — I looked out from under the poncho periodically throughout the night and somewhere in the early hours of the morning I must have drifted off to sleep because when I looked out again it was past morning twilight. I sure felt good that I had survived the night. . . . It was still raining and the seas were running about four to five feet with 20 knots of wind. I drank a limited amount of rain water by lying back in



the raft with my mouth open. The temperature was down, I don't know how cold but a normal low night temperature. It was generally clear to the west. To the north, east and south there was heavy thunderstorm activity and lightning as there had been all night long.

I did not see any aircraft until mid-morning. A plane was well to the north in the same general area as the aircraft the day before so it pretty well confirmed the fact that the search was on.

You hear a lot of noises out there. The water breaking and wave action sound a great deal like aircraft engines. It rather amazed me. . . . Around noon, the sun was high over my head. There was a UF heading right toward me. I got out my last flare and fired the day smoke signal. The airplane made a turn indicating he had seen the smoke. He circled to the left, came back over me and then made a long square pattern. That's when I got the idea that he had lost sight of me. I was concerned about this because I was running out of flares but I was not going to fire that last night flare under any conditions until I was certain I had somebody overhead. At any rate the UF flew around in this square pattern passing fairly close to me. Then he dropped a smoke light—he had me zeroed in.

Not more than 15 minutes later a P-2 (P2V) joined him and they both commenced making identification runs over me. The U-16 (UF) dropped smoke lights to the right and left of me and then circled and dropped an explosive charge of dye marker ahead of me. The dye spread in the water which made it real easy to keep track of me. The P-2 (P2V) made a run and dropped a multi-place life raft about 50 yards astern.

**Debit** — I assumed they wanted me to move out, get hold of the multi-place raft and get into it. Trying to paddle my raft with both hands in a butterfly motion with the pain in my back was the most difficult part of the whole operation. But I figured if I didn't get into that big raft I wasn't going to last anyway so I expended every last ounce of energy I had and I got to the raft. I followed the lanyard (which I had never seen before except maybe on some static display) up to the toggle where there was a lead seal hand grip. I pulled it and it came out real fine but . . . the raft didn't open. I was stuck with a multi-place raft which wouldn't inflate.

**Credit** — I rummaged through the survival kits that were in the raft—radar reflector, paddles,

extra dye marker, things of that nature—then I tied the whole assembly to my raft and drifted downwind from it. At least I would have additional survival equipment. The P-2 (P2V) and the U-16 (UF) made continuous passes to keep me under close surveillance. About a half-hour later the U-16 (UF) dropped a multi-place raft about 50 yards away.

**Debit** — I took a chance and cut everything loose and started to paddle over to the new raft.

**Credit** — I pulled the lanyard and the raft opened and inflated with no trouble at all. I was pretty tired about this time so I hung on to the side of the raft for a few minutes to get a little strength back. This is when I found out that I couldn't have gotten out of that little raft if it had tipped over in the water. I had my Mk-3C life preserver wedged down in middle of the edge of the raft so that I couldn't get it out. I made an effort to get into the big raft and rolled and fell into it. I took the little one with me lock, stock and barrel. The big raft was half full of water—it was a real chore to bail that thing out. I found if I hung on with one hand and bailed with the other, my back didn't hurt so much, but when I used both hands to bail, it was all I could do to lift the two-quart container up over the side.

The U-16 (UF) made another pass and dropped a parachute with what appeared to be a roll of some sort of survival equipment. It was off the wind line. I assembled an oar as rapidly as I could and tried to paddle over to it but after only two strokes I just had to give it up right there. I couldn't move that raft and I couldn't paddle so I let the survival pack drift by and couldn't do anything about it. At least I knew I had been located and was in a bigger raft and fairly safe if I had to spend another night.

**Debit** — I assembled a radar reflector and tied it to the side but I couldn't find the pole. ("Poles" in all multi-place rafts are made by rigging sections of oars. -Ed.) Although it was getting hot out there, moving around in the raft with the thing half full of water and with the wind blowing against my wet flight suit, I began to chill rapidly. I got the shakes.

**Credit** — I pulled out one of the small tarpaulins and wrapped it around me to keep the wind off. I warmed up right away. Except for three or four spongyfuls of water I just about had the raft bailed out.

**Debit** — Then I couldn't do it any longer . . . I just collapsed in the bottom of the raft and stayed there and dozed on and off. I woke up cold as could be so I tried to kneel and move around as much as I could.

**Credit** — I got busy bailing out again and tried to arrange the rest of the equipment. By this time there was a U-16 (UF) high, a U-16 (UF) low and a P-2 (P2V) circling. I was certain that I was in no particular danger—I figured it would be at least five hours before anyone got to me and I planned on maybe having to spend the night in the large raft. This wouldn't be difficult; it was comfortable.

**Debit** — My back once again was hurting so much I just dropped down and dozed in the bottom of the raft.

**Credit** — When I looked out again the U-16 (UF) was landing in the heavy sea. The pilot dropped the U-16 (UF) down and drove it over to my wind line. They made a clever approach; he moved out ahead of me, got directly on the wind line, all engines went into reverse and started the aircraft moving back. Then he cut his starboard engine and I started to slide up under the starboard side of the aircraft.

**Debit** — I couldn't reach the line thrown to me. I just didn't have the strength and I missed the approach. The pilot tried to maneuver the airplane into position again and then he just gave up and made a new approach. The only trouble was this time he came right at me and I slid under the port wing float and the port prop which was turning over and this scared the hell out of me.

**Credit** — A man back in the aft compartment kept waving at me that there was nothing to worry about. He eased me in alongside the hatch, got a line over and in nothing flat a crewman was in the raft with me and carried me up into the U-16 (UF). We taxied closer in to an island, and in the lee of the island made an open sea take off.

When I look back on the errors I made — using the survival equipment too rapidly — I see I was too anxious to get out a signal when I should have waited until the aircraft was at least overhead or close by. I have been told this before and I think all of us have, but sometimes when you are in *extremis* you have a tendency to fire off flares or whatever you have. . . .

# SUCCESS STORY

There is no substitute for training and a dramatic example of payoff of survival training took place recently aboard a carrier in the Mediterranean. An RF-8A (F8U-1P) was taxied forward off the catapult with the nosewheel and starboard main wheel on the slippery cat track. The ship's tight starboard turn produced a marked heel to port. A third possible factor aggravating the situation was the 100% turnup of at least one other aircraft with jet blast directed toward the plane in question.

The *Crusader* began to slide laterally across the angle deck toward the port side. As the port main wheel contacted the No. 4 cat track, the nose swung more rapidly to port and the plane continued skidding over the side, nose first at a 70-degree angle to the deck. As the aircraft left the deck edge, the pilot ejected, well outside the escape system's envelope.

The plane was in an approximately 50-degree nose-down attitude at the time of the pilot's actual exit from the cockpit. His trajectory described an arc outboard, away from the ship, and rose to an estimated height of 15 to 20 feet above flight deck level. Witnesses state the controller and stabilizer drogue chutes deployed before the pilot entered the water and that the personnel chute was beginning to stream as he entered the water face first, apparently separating from the seat.

After entering the water, the



pilot reached for the emergency seat release handle but found that he was free of the seat. He inflated his Mk-3C flotation equipment and swam to the surface. After reaching the surface, he released his rocket jet fittings easily. A helicopter lowered the rescue seat within his reach, he straddled it, was hoisted aboard and was returned to the carrier.

What makes this story so unique? Two things. . .

*One:* Over and above the routine training procedures carried out in all squadrons, this pilot along with several squadronmates took part in a personal project to practice operating parachute canopy release rocket

jet fittings. These pilots, as they later reported to Headmouse in the September 1962 *APPROACH*, practiced releasing the fittings while hanging normally in the harness, while in abnormal and unusual positions, and finally with one riser free and all tension exerted on the remaining riser. More important, in light of subsequent events, our pilot practiced operating the rocket jet fittings with his gloves on, with his gloves off, and while wearing gloves that were wet and very slick. In the accident, wearing gloves, he experienced absolutely no difficulty in releasing his parachute canopy. He gives a large measure of credit to his previous practice sessions.

*Two:* And this is the thing that makes this case even more remarkable: During the survival episode the pilot was stunned and *almost blind*. As he hit the water face first, his helmet visor shattered and inflicted severe eye injuries. Nevertheless, his survival training and his ability to quickly execute well-planned survival and escape procedures under the most adverse conditions, coupled with what was described as extraordinary performances by the rescue helicopter and crewman, resulted in his spending a total of *only 52 seconds* in the water following the accident. He was returned to a flying status at the end of 10 days.

This is a story for each of us to think seriously about, asking ourselves "WOULD I HAVE DONE AS WELL?"

# Dehydration

**T**emperatures on the steel deck of the carrier were much higher than the 81° recorded air temperature. The A-4C(A4D-2N) pilot sat in his plane 15 to 20 minutes before launch. He was perspiring profusely but not abnormally, considering the tropical heat. Launch was routine although he stated later that the cabin seemed hotter than usual.

After some 30 minutes' flight at 32,000' the pilot became nauseated, experienced stomach cramps and continued to per-

spire. A check of the oxygen system and cabin pressurization showed everything normal, but he was unable to control cabin temperature to his desired temperature. Nausea became so overwhelming he considered taking off his oxygen mask to vomit.

Shortly thereafter, the carrier broadcast a general recall and the pilot commenced letdown for immediate recovery. Still feeling weak and nauseated and now experiencing some visual impairment as well, he made three

erratic passes to a pitching deck. The third pass terminated with high sink rate at the ramp and a hard landing which collapsed the starboard landing gear. The pilot sat in a daze while the crash crew ran out to the plane. . . .

Salt depletion and dehydration were definite factors in this accident, says the examining flight surgeon. Salt tablets taken at regular intervals during hot weather operations or added salt taken with meals is the remedy.

## Human Balloon

IN CHECKING the flow of high pressure helium from a small orifice, a man placed a finger over the opening. In the matter of a split second, the gas pierced the skin and penetrated the flesh as far as the armpit. His finger was swollen and pale and gas pressure could be felt through the skin along the arm. Immediate medical treatment relieved some of the pressure and restored circulation but it took 4 days for the helium to be completely absorbed.

In this incident the pressure was 6000 psi and the orifice, being only 0.007 inch in diameter, resulted in a needlelike stream of helium traveling at sonic velocity of about 2800 feet per second. It was estimated that the helium, upon expanding in the arm tissue, increased in volume at a ratio of 200 to 1.

Exposure to such extreme pressures is rare, but this accident does serve to remind us that compressed gas streams, whether at 6000 or 60 psi, can be dangerous. Never allow compressed gases to come into contact with the body.

—USN "Safety Review"



notes from your flight surgeon

## Dig In

A CATAPULT spotter directing aircraft on the deck was caught in the jet blast of an A4 (A4D). He was blown into the path of an RF-8A (F8U-1P) being launched. Struck by the starboard wing, he was knocked to the deck. His injuries were compound fractures of the three bones in his right arm, a cut forehead and a brain concussion.

Accidents on the flight deck can occur with great speed and without warning. Try to avoid jet blasts but if caught in one, drop to the deck in a flat spread eagle position and "dig in."

## Crash Crew Training

DURING climbout in afterburner at 22,000 the canopy of the F-8B (F8U-1E) shattered. The pilot was in the process of lowering his helmet visor at the time. Plexiglas fragments cut his hand and broke his helmet visor but his face was uninjured. The ejection seat face curtain was partially blown loose and was trailing.

By not taking proper safety precautions when the *Crusader* landed at home base, crash crewman aggravated an already dangerous situation. They failed to secure the face curtain or safety the seat before they assisted the pilot from the cockpit.

*Aircraft Accident Board's Recommendation:* That crash crewmen be given extensive training on crash procedures for tactical aircraft stressing ejection seat safety. Crash crew units should utilize the latest training devices in rescue techniques.

(How about all of you station and squadron safety officers utilizing that excellent training you received at USC to assist in in-

structing crash crews on crash procedures? The aircraft, the ejection seat, latest revised flight handbooks and Handbooks of Maintenance Instructions along with aircraft manufacturer's crash crew information charts and brochures will serve as your training aids. Don't limit your instruction to aircraft specifically based at your air station. Visiting aircraft are not crashproof.—Ed.)

## Flight Deck Danger

AT 2100 two flight deck crewmen were returning to the flight deck after a smoke break in the crew's spaces just below.

Parked close together near the edge of the flight deck were a group of A1J(AD-7) aircraft. The pilot of the plane parked just behind the one next to the access ladder was in the process of shutting the engine down. Instead of ducking under the nearest aircraft, one of the two flight deck crewmen walked around the tail. In spite of his companion's shouts of warning to look out for the spinning prop, he walked into it and was severely injured.

Both men were dark-adapted—the crew space where they had smoked was red-lighted. However, the area where the accident occurred was not lighted.

Though the victim had had 4 to 5 months on the flight deck, this was his first night back on the flight deck since a two-month tour in the galley.

The flight surgeon's recommendations were:

- That some adequate red-lighting be installed on the forward part of the flight deck on attack carriers.
- That flight deck crewmen who have been assigned to other

duties for a prolonged period of time should spend 3 to 4 days on the flight deck during the daylight hours before they resume their duties on the flight deck at night.

- That periodic lectures in safety and first aid be given to flight deck personnel.

## Tracers

Tracers can be just as effective on land as at sea to signal position. An F-6A (F4D-1) pilot ejected and parachuted down into an open plowed field at dusk. His ankle was broken when he hit the frozen ground. Searchers, however, soon located him by the tracers he was firing.

## "Bizarre"

Pilot protection by an APH-5 helmet is not unusual but here's one that qualifies for "bizarre":

The aircraft was in a near vertical attitude over land when the pilot ejected making the path of ejection in a horizontal plane. (This was an NAMC catapult with zero delay lanyard.) Pilot-seat separation was satisfactory. However, after seat separation, the seat accelerated less rapidly than the pilot. As the pilot's parachute deployed he began decelerating. The seat continued down and passing, struck him on the helmet. The blow lacerated the pilot's scalp through the helmet but did not crack or break the helmet. Part of the helmet's outer coating and reflective tape were missing. When the seat was recovered there were bits of reflective tape and helmet paint at the bottom of the ejection tube. The pilot was partially stunned by the blow and does not remember what happened from that time until helicopter pick up. ●

We've come a long way in aircraft development since the days of the OX-5. With increased horsepower, thrust and temperature ranges came developments in the elixir of engine life. Here's a round-up of the old as well as the new on



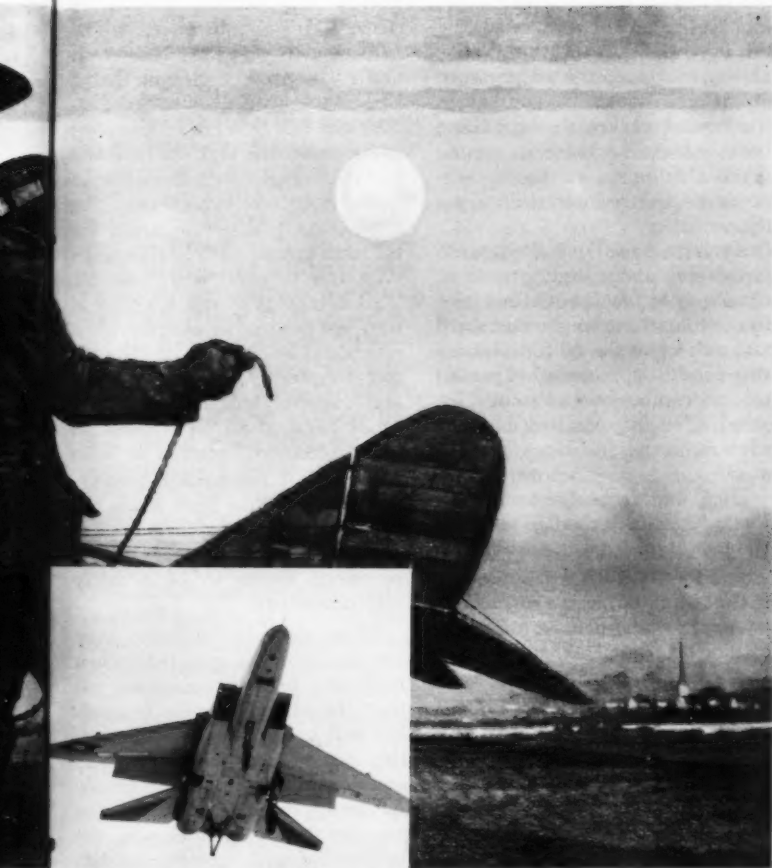
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# ENGINE OILS

Adapted from the "Army Aviation Digest" and  
BuWeps Instruction 10350.1A of April 1963

WITH THE BIG job that oil has to do in our engines there must be many "Whys" and "Whats" about how it accomplishes this mission along with the many problems associated with such a massive operation it has to perform.

When one dry metallic surface is moved over another, a high resistance or friction is encountered, which results in the generation of heat and excessive wear of engine parts. If a layer



of greasy substance or lubricant is placed between the two metallic surfaces, the wear on the metal is practically eliminated and heat is reduced to a minimum. The lubrication system in aircraft engines is designed to meet the problems of high temperatures, high bearing stresses, and proper functioning in all flight attitudes of the aircraft.

An oil must meet certain specifications that will enhance aircraft engine operation. What

then are the desirable characteristics of an aircraft oil? We want an oil with the following desirable properties:

- *Adequately high viscosity.* Viscosity is technically defined as the fluid friction or the body of an oil. In simple terms, viscosity may be regarded as the resistance an oil offers to flowing. A heavy-bodied oil is high in viscosity, i.e., pours or flows slowly, and may be described as a viscous oil. The lower the viscosity the more freely an oil pours or flows at temperatures above the pour point (which is another characteristic that will be discussed later). Oil that flows readily is described as having a low viscosity.

- *High flash point.* Since oil is used to lubricate the cylinder walls and pistons of internal combustion engines, another major factor stands out among the requirements of a good oil. Because of the large amount of heat generated in cylinders during the power stroke, the flash test of an oil assumes considerable importance.

The flash point test is performed by heating an oil sample and, as the temperature rises, by periodically passing a flame slowly over the surface of the oil. The temperature at which the oil vapor above the sample first ignites is recorded as the flash point. An oil of high flash point is preferred because of the greater degree of protection afforded cylinders, pistons, and the like, and the probable lower oil consumption during continuous engine operation.

- *Chemical stability.* A good oil must show a high degree of chemical stability to resist the action of high temperature, moisture, and acids, all of which often are present in engine crankcases.

Continued

• **Low pour point.** Here we come to the problem of cold weather starting, where oil plays a major role. It is not uncommon for internal combustion engines to be started cold at temperatures of 0° F or below. The pour point of an oil is the lowest temperature at which it will pour or flow when it is chilled without disturbance. To determine the pour point, the oil is placed in a glass test jar and cooled in a cooling bath until it ceases to flow. The pour point is determined when the test jar can be held in a horizontal position for five seconds after removal from the bath.

• **High viscosity index.** This desirable characteristic of a good oil is an indication of the viscosity temperature of oils. This index measures the rate of change of viscosity with temperature. The ratings are plotted on an index chart and the oil with a higher number has a higher viscosity.

Oils properly refined from crude petroleum will meet all of the above requirements. To assure that an oil of correct "grade" (viscosity) and quality is used, it is highly desirable to follow the recommendation of the engine manufacturer.

Next, let us look at the problems of oil usage in internal combustion engines. We will look at some of the questions of why some engines use more oil than others and how oil is consumed in an engine. There are three ways in which oil can be consumed in an engine. First, it can be lost by being burned in the combustion chamber; second, through loss of oil mist or vapor from the breather; and third, by leakage where the crankshaft and other shafts protrude from the crankcase.

Other factors also affect oil consumption. Of these, engine

speed is probably the most important factor. The oil pressure increases with speed until maximum pressure is reached, beyond which the pressure relief valve maintains constant pressure. The effect of centrifugal force on the oil in the ducts in the crankcheeks increases the oil pressure at the crankpins. This increases the rate of oil flow through these bearings. An increase in engine speed also increases the oil temperature and reduces the viscosity.

At high speeds, the rings do not follow the cylinder wall as closely as at low speeds, but tend to act something like a surfboard and ride upon the oil film. Under this condition, more oil is passed to the combustion chamber instead of being scraped back to the crankcase, resulting in a loss of oil.

High engine temperature and low oil viscosity tend to increase the loss of oil from the shaft ends and breather pipe.

Condition of engine as to wear is another major factor for the loss of oil. For instance, wear of the various bearings increases the clearance and provides larger areas through which oil can flow out for a given oil pressure. It consequently increases the amount of oil loss by leakage and sprayed on the cylinder walls.

We can also say that when an oil loses its viscosity, or, in other words, decreases in viscosity, the oil consumption increases.

Now that we know why we have to continuously add oil to our aircraft engines, let's discover *why* we have to change oil at different intervals. Oil is constantly exposed in service to many harmful substances, which in time will seriously reduce its ability to protect moving parts. The chief agents of contamination are heavy ends of gasoline, acids, moisture, dirt, carbon, and metallic particles. Because of these injurious substances, it is a common practice to drain the oil from engines at regular intervals and to refill with new oil. This brings us to the question of how we determine exactly when oil should be changed. If changed too frequently, needless waste and expense will result; on the other hand, if an oil is used too long, excessive function or wear will result in mechanical trouble. We can never be sure if we are draining out good usable oil, but a periodic draining as generally practiced seems to be a fairly safe procedure.

When away from home base we should make sure that when replacing lost or consumed oil that the correct grade is used. We will not always be in a position where someone else knows and does the maintenance for us. At many stops or locations the maintenance personnel will not be familiar with military aircraft and the type of oil that should be used. And the civilian oil designation is different from that

### Grade Designation for Aviation Oils

COMMERCIAL AVIATION NO.	COMMERCIAL SAE NO.	ARMY AND NAVY SPECIFICATION NO.
65	30	1065
80	40	1080
100	50	1100
120	60	1120
140	70	

used in the military. So, what should you ask for? No need to sweat, just cut out the table below and stash it where it will always be with you when needed.

The relationship of military grade numbers and commercial SAE numbers (Society of Automotive Engineers) is just a difference in number value. The Society of Automotive Engineers formulated the rating for grade or weight of oil that is used in the United States. We are all familiar with 10 weight, 20 weight, and 30 weight oils. To change SAE numbers to military grade numbers, we multiply by 2 and add 1000. Hence, SAE 50 weight oil  $\times 2$  equals  $100 + 1000 = 1100$ , the designation of the same oil in Army and Navy terms. All military grades of oil are like this except grade 1065, which is approximately the same as SAE 30 weight. In using either viscosity grade scale you must remember that as the oil gets thicker the numbers go up.

To determine the SAE rating of an oil sample, it first is tested at the correct temperature in the Saybolt universal viscosimeter. This gadget is the standard American instrument for testing petroleum products and lubricants. The tests on oils are usually made at temperatures of 100°, 130°, and 210° F. This instrument has a tube in which a specific quantity of oil is brought to the desired temperature by a surrounding liquid bath. The time in seconds required for exactly 60 cc of the liquid to flow through an accurately calibrated outlet orifice is recorded as Saybolt seconds universal viscosity. Whatever range of time and temperature this falls in gives oil its number designation. The higher the temperature and time, the higher the number classification.

The letter W occasionally is included in the SAE number, giv-

ing a designation such as SAE 20W. The W does not stand for weight but indicates that the oil, in addition to meeting the viscosity requirements at the testing temperature, also meets additional low temperature specifications for satisfactory use in very cold climates.

Although the SAE scale has eliminated some confusion in the designation of lubricating oils, it must not be assumed that this specification covers all of the important viscosity requirements. An SAE number indicates the viscosity "grade," or relative viscosity only. Both good oils and inferior oils which have the same viscosities at a certain temperature are subject to classification in the same grade. The difference would probably be in the price, if we were buying it. Just like everything else, a cheaper brand can always be had.

This is the point where the viscosity index chart comes into importance. When comparing two oils on the index chart, sample A oil may be found to have a viscosity index of 95 and sample B (also on SAE 50 oil) may have a rating of only 20. This further emphasizes the fact that an SAE rating alone cannot be interpreted as an indication of quality in lubricating oils. In general we can say that high viscosity index ratings are very desirable in all grades of oil, particularly if low temperature operation is involved.

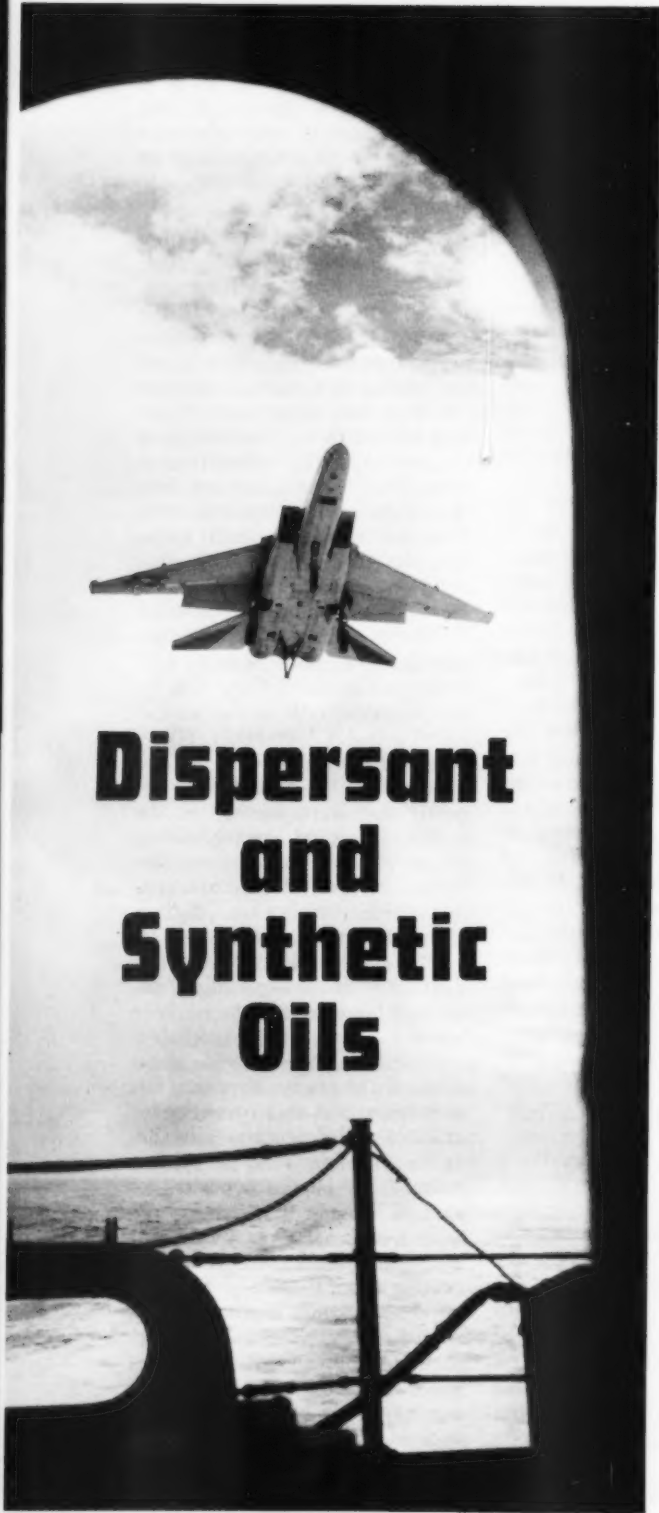
A person usually asks for a certain oil by referring to weight. What is he actually asking for? Nothing more than the specific gravity of the oil. The gravity of a petroleum oil is a numerical value which serves as an index of the weight of a measured volume of the product.

Again, gravity is not an index to quality. It is just a convenient term for use in figuring the

weights and measures of petroleum products. Specific gravity is the weight of any substance compared with the weight of an equal volume of a standard substance.

Now for the problem we may encounter when visiting our counterpart, the Air Force. There will be a problem if the aircraft you are flying consumes a great deal of oil and you did not take pains to bring your own oil. The Air Force uses detergent oil while our reciprocating engines use the nondetergent type. Well, what difference does that make? Detergents are additives which enable oils to maintain the soot, sludge, and other solid materials present in crankcase oils in colloidal suspension. Oils with detergency properties also act to remove deposits previously formed during use of nondetergent oils. If you should start using a detergent oil in place of your nondetergent, all of the soot, sludge, and other deposits that have formed in the crankcase would start breaking loose. Then what? An oil line would probably clog up at a critical moment during takeoff. This seems to be a pretty good reason for carrying a little nondetergent oil with us, especially if we are not landing at a place where we can obtain our old reliable.

Detergency, however, is not a cure-all for engine deposits, but it is important as a property for crankcase lubricating oils because it is effective in preventing coagulation and deposits of sludges on engine parts. Oils with this property not only maintain crankcase and valve chambers in clean condition, but also keep piston rings free and greatly reduce cylinder varnish formation. This all sounds like a good idea but look at the expense of just changing from one type of oil to another. *Continued*



# Dispersant and Synthetic Oils

All naval aircraft piston engines will use a single grade of dispersant type oil purchased under Specification MIL-L-22851(Wep), NATO Symbol 0-128. This is a Grade 1100 base oil with additives to improve oxidation resistance, to hold in suspension sludge and varnish forming particles, and to reduce foaming tendencies. The additives do not form ash when burned and therefore, will not contribute to spark plug fouling deposits in the engine.

Standard oil dilution procedures can be used with this oil in cold weather without the hazard of excessive sludge throwdown which sometimes occurred with the non-additive Grade 1100 oil. For this reason, oil dilution is recommended for cold weather operation rather than the formerly recommended use of Grade 1065 oil.

Dispersant oil, Specification MIL-L-22851 (Wep) is compatible with stocks of Grade 1100 or Grade 1065 oil which may still be in the supply system and with commercial brands of aviation oil. There is no objection to mixing the dispersant oil with these other oils when operational requirements make it necessary. Commercial dispersant type oils essentially equivalent to MIL-L-22851 (Wep) oils include AeroShell Oil W Grade 100 or Grade 120, and Humble/Esso Oil E-100 or E-120.

## Two Cycle Drone Engines

Two cycle drone aircraft engines require a mixture of lubricating oil and gasoline. Either Grade 1100 oil or Specification MIL-L-22851(Wep) dispersant oil can be used in this fuel-oil mixture.

## Cold Weather Operation

Dispersant oil, Specification MIL-L-22851 (Wep), is satisfactory for use at temperatures down to +25°F without dilution or preheat. Below +25°F the dilution and preheat instructions in the Flight Manual are applicable. Experience with dispersant oil has indicated that dilution is satisfactory down to 0°F and that preheat is desirable below 0°F. Oil dilution increases the flammability of vapors issuing from crankcase breathers. Oil, if diluted 20% or more, can be ignited and burned at temperatures above 60°F. Special precautions to prevent fire shall be taken during dilution and the subsequent cold start and "boil-off" cycle. Oil leaks should be corrected and drained oil shall not be handled or stored in confined spaces.

Cold weather operation often causes oil-in temperatures to drop below the minimum required for evaporation of the products of combustion

(water and partially burned fuel) which blow past the piston rings and condense in the cold oil. Continued operation at oil-in temperature below 60°C (140°F) may result in a buildup of water emulsion in the oil which can contribute to the precipitation of sludge that would normally be held in suspension by the dispersant additives in MIL-L-22851(Wep) oil. It is important that engine operating temperatures be maintained above the minimum level. All engine "run-ups" should be performed long enough for the oil temperature to stabilize at the level specified in the applicable aircraft flight manual and for at least ten additional minutes in order to boil off any water that may have condensed in the oil. If minimum operating temperatures cannot be maintained during periods of operating the oil change interval should be reduced to half the normal specified period.

#### 1100 Oil Plus Cyclohexanone

U. S. Air Force facilities will not have MIL-L-22851(Wep) dispersant oil, but instead will supply a Grade 1100 oil to which 2% cyclohexanone has been added. This oil may be added to aircraft using MIL-L-22851(Wep) oil for make-up, as required, without any special precautions.

#### Change Intervals

The oil change interval should coincide with the intermediate calendar inspection as Per Bureau of Naval Weapons Instruction 4700.2 for normal operations with the dispersant oil. This recommendation includes the R3350 and R1820 engines which previously changed oil at 60 hours. Other model engines may be extended beyond the intermediate inspection at the discretion of the type commander on the basis of local operating experience and conditions. The condition of oil screens during periodic inspection and cleaning may be used as one criteria in establishing an optimum oil change period. Shorter drain and desludging intervals may be advisable under cold weather operating conditions as indicated in a previous paragraph of this Instruction. More frequent oil changes are recommended for aircraft operating in areas where dusty field conditions exist. The frequency of oil changes under these conditions will depend on the severity of the dust condition. Failure to change oil more frequently in high dust areas can result in accelerated engine wear.

#### Turbine Engine Oils

Two oils are used in Navy aircraft turbine engines. MIL-0-6081, Grade 1010 is a light petroleum oil used only in older engines such as the J33

and the J34-WE 34/36 engines. The MIL-L-7808 synthetic oil is used on all other turbojet, turbo-prop and turboshaft engines. The synthetic oil has two principal advantages over petroleum oil. It has less tendency to lay down lacquer and coke deposits and less tendency to evaporate at high temperatures. Its principal disadvantage is that it tends to blister or remove paint wherever it is spilled. Painted surfaces should be wiped clean with a petroleum solvent after spillage. Caution must also be observed to use the synthetic oil only in equipment specifically designed for it since seals designed for petroleum oils will swell and disintegrate when in contact with the MIL-L-7808 synthetic oil.

#### Oil Change Intervals

Oil change intervals for turbine engines will vary widely from model to model depending on the severity of the oil temperature conditions imposed by the specific airframe installation and engine configuration. The recommendations of the applicable service instruction manual should be followed.

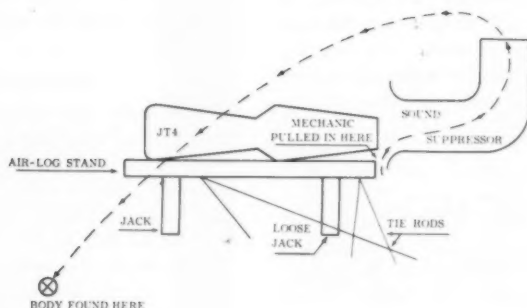
#### Storing and Handling

Dispersant type piston engine oil is received in bulk or in 55-gallon drums. Extra care should be exercised in handling this oil to prevent contamination with dirt or water since, with this oil, settling cannot be counted on to remove contaminants. Bulk tanks should be cleaned periodically. Drums should never be stored where rain can accumulate on drum heads. Oilers and field dispensing equipment should be drained and cleaned periodically. Local conditions dictate the frequency of equipment draining and cleaning. It is almost impossible to completely separate either dirt or water from this oil once contamination occurs. A 200 mesh screen should be used in dispensing units to assure positive removal of coarse dirt.

MIL-L-7808 synthetic oil for turbine engines is supplied in sealed one quart or one gallon metal cans. Although this type of container was chosen to minimize contamination, it has been found necessary to filter the oil again to remove metal slivers, can sealants, etc., which may occur as a result of opening the can. MIL-L-7808 oil should be dispensed to aircraft *only* through a pre-oiler or dispensing unit equipped with a 10 micron or finer filter element. Suitable units are the Pre-Oiler and Pressure Filling Unit, Navy Stock Nos. 4930-654-9071-S030, R4920-645-4071-S030, the PON 5-75 and PON 6.—BuWeps Inst 10350.1A, 3 April 1963

# SUCKED IN!

A recent report received through the Federal Aviation Agency (FAA) presents a graphic example of the destructive forces generated by an operating jet engine. This report is reproduced in part to re-emphasize the importance of exercising proper precautions when in the immediate vicinity of an operating jet engine.



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**T**his jet engine test bed is used to test jet engines after certain engine malfunctions have been corrected by maintenance personnel. The test stand is unhoused, and located approximately 50 feet from a control shed. The engine is mounted on a standard Air-Log 3060 engine mount work stand and secured to the concrete ramp foundation by means of heavy tie rods and support jacks. A 12 x 12 foot shield is located 50 inches forward of the engine inlet cowl. The engine tail pipe is located inside the forward end of a Maxim sound suppressor. The sound suppressor is approximately 30 feet long with the exhaust section pointed skyward.

Two mechanics began a test run of a JT4 engine. Their leadman later arrived at the test shed and asked if a leak check had been made. The mechanics said "yes" and the leadman said he would also check the engine for leaks. (A leak

check consists of a visual inspection of the lines and fittings for oil and fuel leaks while the engine is running.) About three minutes after he left the test shed the mechanics noted a heavy vibration indication on the vibration instrument. One of the mechanics went to investigate the cause of the vibration and found the badly mangled remains of the leadman lying about 10 feet forward and 10 feet to the left of the engine nose. The mechanic had the engine shut down and notified the appropriate authorities.

The mechanic's statement indicates the engine was "running at or about 'part power'" at the time of the accident. Part power is a predetermined setting used in making engine adjustment. At part power the engine is producing about 80% of its maximum rated thrust. There were no eye witnesses to the events leading to the accident.

Physical evidence shows that the leadman was

### Jet Etiquette

Jet engines pose an insidious danger to the ground crewman—the danger of being sucked into the jet intake and being crushed against the inlet guide vanes, or being chopped up by the compressor. The large vacuum area near a running jet engine is invisible and can be easily and inadvertently entered by a preoccupied, tired ground crewman. At a time like this, the margin between life and injury or death may depend solely on whether or not his clothes are tight fitting.

Baggy, loose shirts, rags in the pockets, any loose clothing can make it easier for an engine to grab on and suck a mechanic into its mouth.

The idea is to keep from being swallowed by one of our axial-flow vacuum machines. The best way to accomplish this feat of survival is by wearing close-fitting clothing when working around running engines. In addition, avoid like the plague that invisible but dangerously present jet intake zone.

drawn into the space between the tail section of the engine and the forward bell mouth area of the sound suppressor. This is indicated by marks in the rust on the inside of the suppressor at the 8 to 9 o'clock position. The space between the engine and the bell mouth is 19 inches at this location and tapers to a lesser amount at the six o'clock position. The leadman's flashlight was found about 200 feet forward to the right of the engine and small parts of his body were found scattered over a wide area. The flow of exhaust gases from the suppressor extends over a similar area. There was no damage suffered by the engine and the only abnormal instrument indication noted by the mechanic in the control shed was on the vibration instrument as previously mentioned.

Because no one witnessed the event, conjecture can only be used as to how the leadman was drawn into the exhaust stream. The inspection he had set out to accomplish has been done many times

by himself and other mechanics but usually at idle power settings. The inspection had been accomplished minutes before by the mechanics performing the test. The elapsed time between leaving the control shed and the heavy vibration indication was not long enough to complete the leak check. It is possible that upon approaching the engine from the left side he stumbled over one of the tie rods supporting the engine and fell in such a way that his body obstructed the normal flow of air between the suppressor and the engine. There is one other possibility. The aft left-hand jack, supporting the engine stand, was found loose after the accident. It is possible that the leadman noted this and during his check of the jack he got in a position which resulted in his being drawn into the suppressor. This possibility is not as valid as the first because there are two tie rods in this area which should have kept him from getting into a vulnerable position. Also, maintenance personnel state they have been in the same vicinity of an engine during a "part power" test run and have suffered no ill effects or undue concern.

On March 1, 1963, members of the FAA office witnessed air flow tests made in the vicinity of the suppressor bell mouth. With the engine running in at part power and the use of a manometer probe there was a negative pressure of 12 inches of water reading at the narrowest area between the engine and the suppressor (This represents .43 pounds per square inch of positive pressure.) Eight inches forward of the suppressor entrance there was a drop of one inch of water. At the same power setting the foreman approached the engine and simulated all the movements that would be expected of a mechanic examining the engine. During this time he was within 16 inches of the greatest pressure area.

A guard has since been welded to the forward edge of the suppressor.

**Opinion:**—The struggle against complacency is a hard one, as evidenced by this incident, but it can be won. No matter how routine a job may seem, no matter how inconsequential, safety demands mental alertness—your best insurance for self-preservation.—*Delta Air Lines "Technical Review"* ●

Know the Work Hazards—Don't Learn of Them by Accident.

# Systematic Supervision

HAVE you heard the one about the old-timer who helped write the book on accident prevention but could not remember why? Why?? You know why! And it has nothing to do with those six additional duties you have. We know, too, that environmental conditions can cause you to slip, and this slippage is allowed to happen—we've either got it or haven't got it. Personally, we all like to think we've got it—what it takes to remain the doers—the action types—but thinking it just isn't good enough.

We who are responsible for supervision are responsible for maintaining a working environment free of hindrances, hazards and unhealthy conditions—primarily for the personnel under our control. But, this same environment produces our needs as well as the needs desired by others. The environment we create or allow to exist affects all. It is this obligation to take action to eliminate any and all hazardous conditions that exist or develop in our area of responsibility that controls our very existence—also, those day-to-day “Well Dones” or “Brush Fires.” Can you recall a “Well Done” day? Of course not! Because they are easygoing, no-problem days. The time passes like a one-day holiday. But, let something backfire and load you up with problems or put you in the middle of a brush fire—there's a day none of us forget, mainly because it's a simple could-kick-myself something that could have been prevented, but was allowed to slip.

Procrastination is the word—a human failing, that is not very humane, toward the unknowing fellow human being who then is exposed to human error during an emergency condition which was created by some simple negligence, forgotten step, overlooked condition, or short-cut that occurred hours, days, or even months ago.

Personnel error is the root of our accidents, and we are its best rooters. (Let's face it! If we were playing a game, we'd have to play against ourselves to win. Rooting by itself won't prevent error.)

Though unplanned, as we know, accidents do not just happen. They are caused by unsafe conditions or unsafe practices or a combination of both. To keep accidents reduced to a minimum effectively, it is our responsibility to detect any unsafe hazards. We must

first discover them. To do this, we must use one of the oldest tools in the business: INSPECTIONS.

We, as supervisors, in most cases, cannot make all the inspections (though we are responsible), so we must delegate (not unload or “pass-the-buck”) responsibility by appointing conscientious individuals as our inspectors. Regardless of how many inspections are made by other agencies, we supervisors must have a continuing inspection schedule to meet the needs of *all* activities under our jurisdiction.

Observing and recording are the quickest ways to detect development and often anticipate our personnel errors—before they are ours by way of accidents. To ensure that potential hazards are not overlooked, another old tool will help us cover our specific activities: THE CHECK LIST. Following is a sample of Safety Inspection Check List:

**Activity:** ..... **Date:** .....

(If questionable, write what, where, when, why, who, and how remarks on reverse side.)

- |                                              |                                                             |
|----------------------------------------------|-------------------------------------------------------------|
| 1. Fire Protection<br>( ) "A" OK ( ) ???     | 7. Protective Equipment<br>( ) "A" OK ( ) ???               |
| 2. Housekeeping<br>( ) "A" OK ( ) ???        | 8. Unsafe Practices<br>( ) "A" OK ( ) ???                   |
| 3. Tools<br>( ) "A" OK ( ) ???               | 9. Unsafe Procedures<br>( ) "A" OK ( ) ???                  |
| 4. Machinery<br>( ) "A" OK ( ) ???           | 10. Bulletin Boards<br>( ) "A" OK ( ) ???                   |
| 5. Auxiliary Equipment<br>( ) "A" OK ( ) ??? | 11. Continuing and Current Retraining<br>( ) "A" OK ( ) ??? |
| 6. Pressure Equipment<br>( ) "A" OK ( ) ???  |                                                             |

Unlimited information available from these inspections can be used in training the new and retraining the old personnel, be they our responsibility or someone else's. It will make our activities more “Quality” productive, but above all, hazards (the hindrances) will be discovered and eliminated—reducing to a minimum those unplanned, caused occurrences, along with the injuries or property damages that can result, that disrupt our orderly processes.

This is our goal as conscientious supervisors. We are intelligent people, and SAFETY is simply INTELLIGENT ACCIDENT PREVENTION CONTROLS. Systematic inspection by checklist will help.  
—Robbins AFB

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# MEMO to Maintenance Men:

SEVERAL recent incidents have occurred, some of them resulting in damage to aircraft, which are a result of ignorance of proper maintenance procedures. This is not a suggestion that all maintenance personnel are ignorant of the right way to do the job, but there *are* some and "some" is too many.

The Handbook of Maintenance Instructions provides a detailed guide to most maintenance jobs, and is the source of information which should be con-

sulted by the man who is doing a job which is new to him. It should also be the guide for the experienced man who is responsible for checking-out and overseeing the less experienced workman. The approved procedure is the one described by the HMI and to train a new man to do the job in any other way—even though it may be a quicker and apparently satisfactory way—is irresponsible. Maintenance of aircraft is far too complex, and the results of im-



NOTES AND COMMENTS ON MAINTENANCE

prudent local innovations are too drastic, to allow maintenance procedures to develop by evolution. "We've always done it this way" is an invalid and too frequent reply to a challenge of technique.

An honest error or mistake, though not excusable, is at least understandable since human people are an imperfect lot. It is this error which the quality control inspection is designed to detect and rectify, and it does so rather effectively. Quality control inspectors cannot, however, be relied upon to monitor the maintenance effort in its entirety without considerable duplication of that effort, so individual shops and individual people must accept responsibility for assuring that work is accomplished correctly. As a corollary, these people must recognize their responsibility to avoid *doing* the job, but *incorrectly*. By this, I mean to say that, when a job must be done, the man must admit it if he is not *sure* he knows *how* to do it and then find out how before going ahead.

It sometimes seems easier to plunge ahead ignorantly, hoping that the way to accomplish a task will become evident as work proceeds, rather than to take the time and suffer the imagined humiliation involved with inquiring or consulting the HMI. Reluctance to consult the HMI can also be the result of unfamiliarity with the publication. Unless the men know *how* to find the information they need, the publication remains a mysterious book, and nothing more.

I suggest that you attempt to renew the interest of *all* hands in the HMI and make an effort to become familiar with it yourselves. *A way to promote familiarity with the publication as well as knowledge of assorted facts would be the preparation of an "open book" quiz to be completed by all hands as a practical factors requirement.* This has proven to be a painless but effective way to improve pilot's knowledge of the Flight Manual, and should serve as well in this instance. Preparation of this quiz will be a good opportunity for you to learn, too.

Remember, this memo has been prompted by demonstrated unfamiliarity and disregard of the good book. It's up to you to improve the situation. —R. H. Miller, Safety Officer, VS-26

## Globbered Clutches

A RASH of burned out clutches in air compressors indicates the operators don't know that you must bleed off all air pressure before engaging the clutch. Engaging the clutch against a couple of thousand

pounds air pressure shortens its life pronto. The Manual and the Operators Instruction Plate on the compressor clearly state that the air receiver should be unloaded prior to again starting the engine. Make your operators read that plate, will you huh?—CDR Creider's "Maintenance Flashes"

## Shorted Out

AN F6A (F4D-1) pilot made his takeoff in afterburner into an overcast 1500 feet thick expecting to be ontop in a matter of seconds. Very shortly thereafter witnesses noted the aircraft descending from the overcast at a steep nose-down angle. A nearly flat attitude was observed just before impact with the ground. The aircraft exploded on impact and disintegrated. Fatal injuries were received by the pilot.

Investigation revealed evidence of a Servo Rudder Actuator malfunction due to a loose wire (S-2 terminal) on the follow-up syncro—see photo. All wire connections to the follow-up syncro had been coated with Glyptol but had broken loose on the S-2 connection.

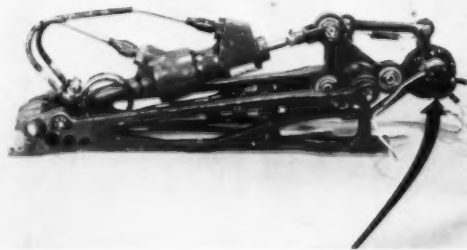
The loose wire at the S-2 terminal, when moved or grounded, caused the servo rudder to move to the left intermittently, sometimes going to full left or hard over position.

A worn out bearing in the follow-up linkage was also discovered but determined not to have figured in the accident.

Recommendations included:

(1) that inspection of the Servo Rudder Actuator unit be made every 30 hours;

(2) that all F6A pilots be thoroughly indoctrinated in the most effective procedures to employ in the event of hard over Servo Rudder. Use of the manual lower rudder will override the Servo Rudder and Elevon interconnect and is much more effective in picking up a wing than the elevon at slow airspeeds.



Loose wire S-2 caused malfunction of Rudder Servo, loss of pilot and plane



**HOLD IT!** An A-4C (A4D-2N) plane captain was sleeping in the cockpit. The plane pusher who came to tell him that his aircraft was to be untied and moved thought he had awakened the brake rider and stated he received a "thumbs up." Obviously, the plane captain was not fully aroused and did not hear and respond to the signal for brakes until it was too late.

## Wheel Build-Up

Nose wheel misassembly and overtightening of nose wheel bolts figured in this F-8B (F8U-1E) mishap.

The pilot took off on a scheduled night field mirror landing practice flight. An examination of the previous yellow sheets disclosed a test hop with no nose gear discrepancies and a FMLP hop with a pilot's reported complaint of "nose wheel shimmy." In order to correct this condition, the nose gear tire was changed. The nose gear tire was pressurized to 265 psi and supervised by the flight line chief.

No discrepancies were uncovered during the pre-flight. In starting, taxiing or during takeoff, the pilot noted nothing unusual. Upon making his approach all gear indicated down and locked, fuel state was 2500 lbs. A normal approach and touchdown was accomplished. The landing was a little fast but not 3-point or nose-wheel-first. At the instant of impact the nose wheel exploded.

While making two low passes a search of the runway was initiated. Rims of the nose wheel tire were found on the runway and it was determined the tire had parted from the aircraft. The fork assembly or a portion of the fork assembly was observed by the LSO to be on the aircraft during the low passes. A final landing was delayed until a lower fuel weight was attained. The runway was foamed with a 30-foot wide strip down the centerline from the 5000' marker for a distance of 1500'. An otherwise normal landing was made with fuel weight of 1000 lbs.

The accident investigation board recommended that the quality control check conducted on the as-

sembly of nose wheels should be extended to include the proper torque of tie bolts and nuts.

Commander, Naval Air Force, U. S. Pacific Fleet, had this comment:

"While it appears that the personnel concerned in both the build-up and installation of wheel assemblies were well versed in and, as a rule, were applying correct procedures, an error was made by someone during the build-up. Some of the tie bolts and nuts were overtightened, some of the old nuts were reused or a combination of both occurred. This is an excellent example of a case in which, even though all the correct procedures were instigated and apparently being observed, errors still occur."

## Well Done VMF-334

Here is an excellent example of how conscientious troubleshooting of flight controls can save pilots and airplanes and down time on aircraft. This is the gist of an AmpFUR submitted by VMF-334, and forwarded to APPROACH by BuWeps.

On takeoff pilot experienced trim cycling intermittently from full left wing down to full right wing down with stabilization system on and off. At one point plane was in 90 degrees angle of bank; pilot recovered from this attitude and made a safe landing.

Aircraft was met in hot brake area by maintenance personnel who observed position of aileron control linkage prior to shutdown. It was observed that when aileron trim was utilized the aileron did not move but the pilot's control stick did move.

Investigation under the wing well disclosed that the aileron linkage forward of the aileron feel and trim control system would move when trim was utilized. The linkage aft of the assembly was stationary. The engine was shut down and all access panels downstream of the aileron feel and trim control system were opened.

Inspection revealed a stress fastener receptacle lodged between bellcrank assembly and bellcrank assembly left hand. Aircraft was turned up in this condition and trim system actuated; control stick moved. Ailerons did not deflect. Stress fastener receptacle was removed from bellcrank assemblies and aircraft turned up. Trim system was actuated, ailerons deflected normally and stick remained stationary.

The aileron linkage forward of the aileron feel and trim assembly was visually inspected with negative results. Scored area on the bellcrank assembly was cleaned and the aircraft returned to flight status.



# Letters TO APPROACH

## Tin Can Training, Tops

**FPO N.Y.**—The description of the rescue techniques employed by destroyerermen was accurately and interestingly explained. Your article and the understanding it will promote, will provide aviation personnel with a lot more knowledge on what to expect from the destroyer and therefore better prepare them to assist in their own rescue.

Your readers can be assured that training for rescue destroyer duties is a continuing program in Cruiser-Destroyer Force, U. S. Atlantic Fleet and that the highest degree of proficiency in this regard is our constant aim.

R. H. SPECK, RADM  
Commander Cruiser-Destroyer  
Force, U.S. Atlantic Fleet

## 'Destroyer Rescue'

**FPO San Francisco**—It is requested that Commander Destroyer Flotilla ONE be provided 50 additional copies of the article "Destroyer Rescue" by Major H.G.C. Henneberger contained in the May 1963 issue.

If the above request can be fulfilled, distribution of this article will be made to all DD types under Commander Destroyer Flotilla ONE/Commander Destroyer Group Westpac.

J. E. MURRY, JR.  
By Direction

## Upwind Approach

**Salem, Mass.**—After reading the excellent article "Destroyer Rescue" by Major Henneberger in the May issue, we have made it required reading for our helicopter and crash boat crew.

One precaution should be observed in approaching from upwind. If the chute is still attached, a drogue effect is exerted on the pilot. A ship being

VP-44 P3A Parachute Riggers Weekly Aircraft Inspection Form		Date Due	
"The Squadron with the Forward Look"			
17 Parachutes	1.		
17 RIA Expos. Suits	2.		
Mk-1 Expos. Suits	3.		
1 Life Raft, Stbd.	4.		
1 EEC, Stbd.	5.		
1 Life Raft, Port	6.		
1 EEC, Port	7.		
1 Gibson Girl, Stbd.	8.		
17 Harnesses, Aft	9.		
2 First Aid Kits	10.		
2 Crash Axes	11.		
White Reflector Tape, port side stenciled	12.		
Remarks: Discrepancy and Corrective Action			
Name of Inspector (print)	Side No.	BuNo.	Date Signature

set down on the pilot may drift over him if the chute cannot be quickly detached. This happened recently to a dummy during search and rescue exercises with the result that the ship drifted over both the chute and the dummy.

J. M. WATERS, JR., CDR  
U.S. COAST GUARD AIR STATION

## 'What's Your Angle?'

**Chicago, Ill.**—We would like permission to reproduce in our "Cockpit"—the monthly newsletter to our flight officers, the article in the May 1963 issue entitled "What's Your Angle?". Credit will be given your publication and the author.

I. E. SOMMERMEYER  
VICE-PRESIDENT-FLYING  
UNITED AIR LINES

• Permission granted.

## Rigger's Inspection Sheet

**Pax River**—As requested in Approach, January 1963, I am forwarding an inspection sheet which Patrol Squadron 44 devised for use on P3A (P3V-1) type aircraft. This type check sheet seems to work very well. Our biggest problem is trying to keep it in continuous use. The reason it is as hard to keep in continuous use is the shortage of qualified riggers as stated by F. M. Sullivan, PRCS in his real fine article in the January issue.

A. H. ASHUKIAN, PRI  
PATRON 44

## 'Wash or Pit'

**London**—A great deal of interest has been displayed by the British Admiralty, the Ministry of Aviation and Bristol Siddley Engines Limited (the manufacturer of the British version of the T58 engine) in the article

"Wash or Pit?" in the May 1963 issue.

It is requested that four additional copies be provided this office for distribution.

R. L. VON GERICHTEN, CDR  
Assistant Naval Attache for Air

## Salt Water Ingestion

Philadelphia—Just a few lines on your latest product—error that is—don't have time for the plaudits.

May issue—page 38—paragraphs describing illustrations in figure 2 not compatible with 2B and 2C.

JOHN MILLIRON  
NATSF

● You are correct. Fig 2b depicts a zero wind condition and Fig 2c depicts a 20-knot wind condition instead of vice versa.

## Sea Water

Stamford, Conn.—Request one copy of the April 1963 issue. . . . We are particularly interested in the article, "The Danger of Drinking Sea Water."

We understand that this article is based upon a Maritime Safety Committee sponsored World Health Organization symposium on this and related subjects. . . .

MARY ELLEN PADIN  
Dunlap & Associates, Inc.

## Last Resort Escape

NAS, Sanford, Fla.—As a result of two recent A-5A (A3J-1) accidents in which the aircraft left the runway, the subject of emergency escape from the pilot's cockpit on the ground came up for discussion in this squadron.

Both of the pilots in these accidents were able to exit their cockpits successfully, one using the emergency canopy jettison system, and the other having the canopy lifted by the crash crew after he had unlocked it. The second pilot chose not to use the jettison system because of the proximity of his BN and the crash crew.

The possibility of the pilot having to break his way out through the canopy was considered worthy of investigation. The jettison system is considered very reliable but fuselage position or structural damage could prevent it from being used or functioning normally.

Cutting through the canopy plexiglas seemed the most obvious alternate method of emergency escape and one which has worked successfully in many other aircraft. The A-5A (A3J-1) appeared to be a little more of a problem, however, since the plexiglas in the canopy is 5/8" thick. . . . Some of the conclusions we reached as a re-

sult of extensive tests using two surveyed canopies are:

1. With the A-5A (A3J-1) and possibly other heavy duty canopies, the time required for the pilot to cut himself out is prohibitive for escape under critical conditions.

2. If all other means of removing the canopy fail, use of the .38 cal. pistol to blast out, though possibly hazardous from the standpoint of fire initiating, is a rapid and effective method of escaping through the canopy.

3. Failure of any rounds to penetrate is not considered significant since the plexiglas will be cracked and weakened and no ricochet hazard is apparent.

4. Though five rounds were fired in our test we believe that as few as two or three could effectively weaken the plexiglas so that it could be broken out.

Some precautions to be observed while using this blast-out procedure are:

- Wave any outside personnel well clear of the aircraft prior to firing.
- Keep oxygen mask on tight to protect face and minimize fire hazard.
- Put helmet visor down to protect face and eyes.
- Hold the pistol perpendicular to the canopy and leave gloves on.
- Fire all rounds in the pistol into the canopy prior to using the pistol as a club. This will eliminate the possibility of accidental firing while holding the pistol by the barrel.

Though these tests were conducted to evaluate escape from the A-5A (A3J-1) pilot's cockpit, the procedure might be applicable to pilots of other aircraft under certain circumstances. If a pilot were injured and unable to use his knife, or for some reason had no knife available, this procedure could be used with a minimum of effort.

The A-5A (A3J-1) bombardier-navigator's window is too small to permit escape through it, so this blast-out procedure is not applicable to B/N's. However, the B/N's opportunity to use this canopy jettison handle before the aircraft comes to rest is much better than the pilot's.

APPROACH welcomes letters from its readers. All letters should be signed though names will be withheld on request. Address: APPROACH Editor, U. S. Naval Aviation Safety Center, NAS Norfolk, Va. Views expressed are those of the writers and do not imply endorsement by the U. S. Naval Aviation Safety Center.

It should be emphasized that "shooting your way out" is a last resort measure to be used only when all other means have failed and immediate escape is required. The hazards of possible fire ignition or harm to personnel outside the aircraft should be considered before using this method.

D. J. KERSHAW, LDCR  
SAFETY OFFICER, HATRON 1

● Re the second pilot's choice not to use the canopy jettison system because of the proximity of his B/N and the crash crew, A-5A (A3J-1) canopies are not designed for jettison from non-moving aircraft. Canopy jettison trajectory is nearly straight up and straight down. The canopy weighs approximately 115 lbs.

You state the crash crew lifted the canopy after the pilot unlocked it. According to the NAA Crash Rescue and Firefighting Information Manual, A3J, NA58H-482 (Rev. June 1962), normal cockpit entry is accomplished by approaching the airplane from the left side and opening the canopy controls access door. Push both toggle valve arms up to open and hold until canopies are full open (takes 3 to 5 seconds for canopies to start opening and from 5 to 8 seconds to reach full open position). The canopy system is pneumatic and there is no danger from electrical sparks.

The flight manual states that in such emergencies as intentional ditchings or landing emergencies, canopies should be jettisoned prior to the aircraft coming to rest.

## It's (Ay)viators and (Ay)viation

Pensacola, Fla.—Maybe it doesn't really matter much if half the (ay)viators (long a) say (aa)viator (short a) and the other half of the (aa)viators say (ay)viator. Or does it? To many (ay)viators it would seem that they, as a big band of brothers, might improve their bonds of brotherhood by all calling themselves by the same name—and pronouncing it the way the dictionaries prefer.

The submariners had this same problem years ago and decided to solve it. They decreed "submareener" instead of "submarriner."

The Naval Air Training Command has decided to go for (ay)viation. The first indoctrination lecture given to flight students coming to Pensacola starts off: "You are to become naval (ay)viators—not (aa)viators." The Class A schools of the Naval Air Technical Training Command at Memphis are also introducing the long A for (ay)viators. — sio

# approach

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in the preservation of lives and equipment and increased mission readiness.**

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# 'TROUBLE COMES IN ONES'

Maybe you've heard the remark, or possibly you've quoted the old adage yourself on occasion: "Trouble (accidents) comes in threes." The quotation is usually prompted by the occurrence of a second accident/incident within a relatively short span of time. Thereafter, often long afterwards, the adage-quoter awaits the fulfillment of his prediction.

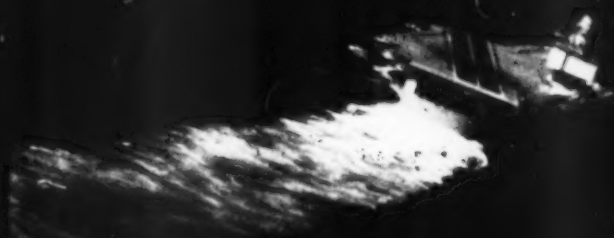
Now, most of us are inclined to regard this sort of gloomy sooth-saying as being long on superstition and short on statistical validity. We submit that trouble comes, not in "threes" but in "ones," and in support thereof offer, not tea leaf reading data nor astrological surveys—merely the record. Test it yourself.

Nearly all of our troubles in aviation stem from "ones": one missed check-off list item; one missing cotter pin; one unattached lock-wire; one inadequate inspection; one short-cut; one violation of standard procedure; one error directly traceable lack of training and indoctrination . . . the list is long, but the facts impersonally pinpoint almost every accident/incident to have its basic cause in one act of commission or omission—usually initiated by one person.

Nope, clairvoyance has nothing to do with the problem, or the solution; the significance of second-sight is zilch. We offer a more positive means of predicting improved flight operations. Namely: for second sight substitute a second look—at the ways you and your people do things. Rather than resign yourself to the inevitability of trouble, assign yourself to the elimination of that one error, by one person, and prevent trouble. Therein remains one major source of safer, more effective flight operations. Are you one for it?



APPROACH is distributed on the basis of one copy per 10 or so people in your unit. Pass this copy along to another shipmate. *The accident you prevent may be his!*



# What landing approach gives

unit.  
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